

79th Annual Research Report
RICE RESEARCH STATION

Crowley, Louisiana
1987

LOUISIANA
AGRICULTURAL EXPERIMENT STATION
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AGRICULTURE RESEARCH SERVICE
COOPERATING



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INTRODUCTION

Research work at the Rice Research Station, Crowley, Louisiana, is conducted cooperatively by the Louisiana Agricultural Experiment Station and the United States Department of Agriculture, Agricultural Research Service. The 1987 rice research program included breeding, variety testing, production and distribution of foundation seed, fertilization, soil and water management, cultural practices, weed control, insect studies, disease investigations, rice drying, bird control in rice, and physiology studies. Forages and crops grown in rotation with rice were evaluated relative to increasing the efficiency of land use. The research program of the Rice Station also includes experiments in the nutrition and management of beef cattle and aquacultural experiments. The aquaculture research program places emphasis upon production practices, crawfish forages, and multi-cropping of crawfish with agronomic crops. Although most of the research work was performed by members of the Rice Station staff, several staff members from Baton Rouge conducted research at this station.

The research activities of this station include both fundamental and applied research, although the latter predominates due to the objectives of branch station work. Research accomplishments and general progress of the Rice Station during 1987 are presented in this report representing the 79th Annual Research Report of the Rice Research Station, Louisiana Agricultural Experiment Station, L.S.U. Agricultural Center.

In addition to research responsibilities of the Rice Research Station staff and cooperators, a large number of farmers, extension personnel, and others were trained and otherwise contacted during 1987. Approximately 700 persons attended the annual Rice Research Station field day to view plots and participate in discussions of research findings and about 400 attended the Crawfish field day. Field days were also conducted in East Carroll, Morehouse, and Vermilion parishes. In addition, the staff participated in industry meetings, both on and off the station, and worked individually with farmers and others in solving immediate problems. Several thousand people received services from the Rice Research Station during 1987.

Projects at this station are conducted under the supervision of research workers from the Rice Station and also by cooperating personnel from certain departments of the Louisiana Agricultural Experiment Station. Following the reports is a list of station personnel and cooperators in 1987.

MONTHLY RAINFALL DATA
RICE RESEARCH STATION -- CROWLEY, LA
1987

Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year Total
1		.10					.05						-
2							.14		.03				-
3					.54	.10	1.03		.02				-
4	.24	.70	.72			.88	.32						-
5		.72									1.46		-
6		.12					1.16	.05		.34			-
7	.13							.10			.27		-
8						.22	.02						-
9	.04					.09	.15	.04		.97			-
10	.57	.25		.02		.16	.16	.29		.41		.78	-
11	.25			.08			.05	.28				.79	-
12			.75			.10	.28	1.27		.45		.02	-
13			.62	.24					.02	.60			-
14				.22		.20				1.12			-
15		.20										.80	-
16					.02				.18			1.40	-
17	.05	.10							1.50			.03	-
18	.25				.36				.01		.01	.06	-
19			1.64		1.02							.68	-
20				1.35		.15					.27		-
21						.77	.03		.79		.39		-
22						.03		.10	.53			.22	-
23	.02							.51	.49	.72	.19	2.17	-
24							.08		.05	1.16	1.23	.01	-
25	.38				.53				.20	.02	4.26		-
26	.02				2.10	.17	.09		.09		.12		-
27					.04	1.30	.57		.01				-
28				.10	.25				.15				-
29				.12	.08	.87							-
30					.79	.21			.03				-
31					.10								-
Mo.													
Total	1.95	2.19	3.73	2.13	5.83	5.25	4.13	2.64	4.10	5.79	8.20	6.96	52.90
1985	6.13	5.59	3.70	2.30	5.71	3.85	4.62	6.03	5.38	17.13	3.40	4.12	67.96

RICE BREEDING

DEVELOPING IMPROVED RICE VARIETIES FOR LOUISIANA^{1/}

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INTRODUCTION

LAES Project 2288 was initiated at the Rice Research Station in 1982. The objectives of this project are as follows:

1. To develop improved rice varieties for Louisiana having increased yielding ability, resistance to lodging, fertilizer responsiveness, disease and insect resistance, improved seedling vigor, herbicide tolerance, and improved grain, milling, and culinary qualities.
2. To develop and/or improve methods of rice breeding, selection, and evaluation.
3. To conduct basic rice genetic studies of interest to rice varietal improvement.

This report describes the research conducted by the Louisiana rice breeding project including the results of experiments and varietal tests conducted in 1987.

SUMMARY

An accelerated rice breeding program for Louisiana was initiated in 1982 to develop improved rice varieties for Louisiana. The 1987 rice breeding nursery covered approximately 19 acres including 18,000 breeding rows, 300 F_1 transplant populations, four acres of F_2 populations, 400 4 x 6 water-seeded plots, and approximately 1,500 yield plots. X_2 populations of four different lines were grown. Since its inception, 1,153 new crosses have been made for varietal improvement. The increased nursery size and breeding activities reflect a large expansion of rice varietal improvement activities for Louisiana. A strong emphasis is continuing to be placed on developing lodging resistant semidwarf lines with high yield potential. Yield testing continues to include both water- and drill-seeded tests, and laboratory seedling vigor testing is conducted on all advanced progeny rows. Pest resistance of promising selections is being evaluated by cooperating research projects. Particular emphasis is being placed on trying to incorporate higher levels of disease resistance, especially to sheath blight. On-farm tests of advanced selections were continued in Vermilion, Rapides, Morehouse, and East Carroll parishes. These tests provide needed information of the performance of experimental selections in different environments. Three advanced experimental lines were tested in N rate and timing studies by the Rice Fertilization and Cultural Management project. Experimentals 8502201 and 8502203 are early

^{1/} This research is supported in part by funds provided by rice producers through the Louisiana Rice Research Board.

semidwarf long grains which have compared favorably to Lemont. Purification and testing of 8502201 in 1988 will continue. An induced semidwarf mutant of 'Della,' 8502186, was tested extensively in comparison with Della in 1987. Advantages over Della were present in "lodging situations," however, evaluations for purity and uniformity of 8502186 will be continued in 1988.

COOPERATIVE UNIFORM REGIONAL RICE NURSERY

Description. Public rice breeders in the U.S. conduct cooperative yield nurseries in which commercial varieties and experimental lines are grown and evaluated at experiment stations in Arkansas, Louisiana, Texas, and Mississippi. This test is coordinated through the USDA in cooperation with the state agricultural experiment stations. The nurseries are grown to test adaptation of the entries in the diverse rice producing environments in the southern U.S. The entries in the 1986 nursery included material from Arkansas, California, Louisiana, Texas, and some cultivars from foreign countries. Information on performance characteristics is compiled and stored in the Rice Data Bank by the Department of Experimental Statistics, Louisiana Agricultural Experiment Station, LSU Agricultural Center.

Experimental design. The nursery contains seven test groups organized by maturity. All groups were grown in a randomized complete block design with four replications in groups I to IV and two replications in groups V to VII. Entry numbers from each state were assigned in sequence (e.g., 1, 21, 41, 61, 81, 121, and 161 were from Arkansas; 2, 22, 42, 62, 82, 122, and 162 were from Louisiana; and 3, 23, 43, 63, 83, 123, and 163 were from Texas).

Agronomic practices. Fertilizer was incorporated preplant at a rate of 130-68-68 lb/A total NPK. An additional 20 lb N/A was applied June 16, 1987. Experimental plots were 53 inches wide and 18 feet long. Treated, presoaked, germinating seed was hand broadcast into the water and all plots were seeded at 150 lb/A rate. The plots were drained to allow seedlings to anchor and a shallow permanent flood applied until harvest. Seeding dates were as follows: groups I and V, April 8 and groups II, III, IV, VI, and VII, April 9. Visual subjective seedling vigor ratings were made as the rice emerged through the water and other agronomic data collected during the growing season. Propanil, Bolero, Londax, and carbofuran were applied at recommended rates for weed and water weevil control, respectively. At maturity, the plots were trimmed to 16 feet and the entire plot (71 ft²) harvested with a small plot combine. A small milling sample was taken from the borders of the plots of two replications for each entry. Samples were dried to approximately 12% moisture on a small sample dryer and yields, moisture, and milling determined. All yield results are reported at 12% moisture.

Comments. Tables 1 through 7 show the mean values for the agronomic characters measured. Cool temperatures were encountered after seeding, making seedling vigor differences quite distinct. The 1987 Louisiana semidwarf entries did show improved levels of seedling vigor indicating good progress has been made on this breeding objective. Blast was present in the nursery and was particularly severe on 'CM-101.' Low yields on many semidwarf entries were the result of poor stands because of low levels of seedling vigor. Lodging of tall entries also was a major factor in reducing yields. Entries 42 and 45 are the advance experimental lines 8502203 and 8502201, respectively. Entry 155 is an induced semidwarf mutant of the aromatic variety Della. Louisiana experimental

TABLE 1. AGRONOMIC PERFORMANCE OF 1987 UNIFORM RICE NURSERY, GROUP I. CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
3	L	5	76	43	0	7130	A	60-70
2	L	4	79	37	0	6994	AB	57-68
TEBONNET	L	5	79	51	5	6884	ABC	60-69
5	L	4	78	39	0	6791	ABCD	59-70
8	L	4	80	39	0	6765	ABCD	63-70
1	L	5	82	45	32	6498	ABCD	57-70
6	L	8	79	36	0	6280	ABCD	52-67
7	L	4	79	44	17	6214	BCD	56-69
SKYBONNET	L	5	81	51	8	6198	BCD	64-70
10	L	4	77	46	77	6078	CD	52-67
11	M	3	78	40	3	6060	CD	64-68
LABELLE	L	5	77	51	40	6039	CD	58-67
9	L	8	79	38	0	5976	D	58-70
4	L	6	82	51	22	5950	D	61-68
BOND	L	6	78	45	45	5159	E	54-67
12	L	9	81	36	0	4149	F	57-66
C.V.		8.9	1.2	2.4	--	8.5		4.5-1.6

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** SUBJECTIVE RATING 1 TO 9, WHERE 1 = EXCELLENT, 9 = POOR.

*** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 2. AGRONOMIC PERFORMANCE OF 1987 UNIFORM RICE NURSERY, GROUP II. CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
31	L	5	80	36	0	6996	A	57-69
25	L	4	80	36	0	6926	A	61-70
28	L	5	81	37	0	6841	A	65-71
MERCURY	M	3	81	39	5	6785	A	66-70
24	L	4	80	45	3	6747	A	56-70
30	L	5	85	44	45	6691	AB	52-69
21	L	4	82	44	0	6634	AB	59-68
22	L	4	78	37	0	6533	ABC	60-70
MARS	M	3	86	48	35	6239	ABC	68-70
26	L	6	82	36	0	6113	ABC	63-71
27	L	4	80	45	10	6069	ABC	53-67
23	L	7	79	37	0	5897	ABC	62-70
29	L	7	83	37	0	5571	BC	56-67
REXMONT	L	6	82	35	0	5455	C	54-66
32	L	5	80	33	0	5453	C	54-68
LEBONNET	L	3	83	49	80	5418	C	61-69
C.V.		12.4	1.2	2.9	--	10.9		3.2-1.6

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** SUBJECTIVE RATING 1 TO 9, WHERE 1 = EXCELLENT, 9 = POOR.

*** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 3. AGRONOMIC PERFORMANCE OF 1987 UNIFORM RICE NURSERY, GROUP III. CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
47	L	5	82	39	0	7094	A	56-70
42	L	5	82	35	0	7074	A	63-70
46	L	5	80	47	0	6923	A	54-66
45	L	5	83	36	0	6827	AB	62-70
41	L	5	83	40	0	6799	AB	65-72
50	L	4	86	49	3	6796	AB	61-69
LEMONT	L	5	86	37	0	6774	AB	62-70
51	L	4	83	36	0	6726	ABC	56-66
GULFMONT	L	5	84	38	0	6622	ABC	63-70
TORO-2	L	4	85	44	0	6582	ABC	65-71
48	L	3	80	35	0	6560	ABC	53-66
49	L	7	84	37	0	6517	ABC	65-71
52	L	6	81	33	0	6247	BCD	63-70
44	M	4	85	50	5	6163	CD	65-67
43	L	9	88	38	0	5731	D	62-69
NEWBONNET	L	5	88	44	0	5719	D	58-66
C.V.		10.2	1.3	2.7	--	5.3		2.0-1.0

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** SUBJECTIVE RATING 1 TO 9, WHERE 1 = EXCELLENT, 9 = POOR.

*** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 4. AGRONOMIC PERFORMANCE OF 1987 UNIFORM RICE NURSERY, GROUP IV. CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
68	L	5	83	41	0	7763	A	61-70
65	L	4	81	39	3	7079	B	56-70
RICO 1	M	6	91	47	45	6993	B	59-72
74	L	5	84	39	0	6774	BC	58-68
70	L	4	88	44	0	6668	BC	58-69
62	L	4	80	37	0	6618	BC	55-69
73	L	4	84	46	0	6617	BC	48-69
71	L	5	83	37	0	6555	BC	61-70
63	L	8	87	39	0	6530	BC	58-69
64	L	5	85	47	10	6491	BCD	62-68
67	L	6	94	48	0	6362	BCD	59-69
69	L	7	86	37	0	6326	BCD	57-70
61	L	5	90	50	8	6176	CD	55-68
72	L	8	84	39	3	6133	CD	63-68
66	L	8	85	39	0	6032	CD	63-69
STARBONNET	L	5	97	49	0	5748	D	61-68
C.V.		8.2	1.2	3.3	--	7.2		3.1-1.1

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** SUBJECTIVE RATING 1 TO 9, WHERE 1 = EXCELLENT, 9 = POOR.

*** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 5. AGRONOMIC PERFORMANCE OF 1987 UNIFORM RICE NURSERY, GROUP V. CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
106	L	3	78	36	0	6801	A	57-68
87	L	4	82	45	0	6771	A	54-67
97	M	3	84	41	0	6708	AB	68-71
96	L	5	83	48	15	6705	AB	58-69
102	L	5	82	46	0	6641	ABC	57-69
94	L	4	82	36	0	6565	ABCD	64-71
84	L	3	75	41	0	6541	ABCDE	58-69
99	L	5	85	43	0	6520	ABCDE	63-67
90	L	4	77	46	15	6453	ABCDEF	61-69
109	L	4	79	39	0	6367	ABCDEFG	58-70
100	L	4	80	34	0	6364	ABCDEFG	56-68
111	L	5	83	49	0	6358	ABCDEFG	62-69
108	L	5	83	47	0	6315	ABCDEFGH	61-68
85	L	6	76	33	0	6311	ABCDEFGH	52-68
88	L	3	80	35	0	6270	ABCDEFGHI	62-70
114	L	4	81	46	0	6188	ABCDEFGHIJ	60-67
105	L	3	78	40	0	6132	ABCDEFGHIJ	63-69
103	L	4	79	33	0	6093	ABCDEFGHIJ	57-69
L-202	L	3	76	36	0	6007	ABCDEFGHIJ	49-65
112	L	3	75	41	0	6004	ABCDEFGHIJ	55-68
81	L	4	75	40	0	5888	ABCDEFGHIJK	55-66
93	L	4	74	40	5	5869	ABCDEFGHIJK	51-68
115	L	4	80	36	0	5847	ABCDEFGHIJK	55-67
98	L	6	84	37	0	5741	ABCDEFGHIJK	51-67
110	L	5	79	33	0	5606	BCDEFGHIJKL	45-64
113	L	5	80	37	0	5553	CDEFGHIJKL	56-67
86	L	5	78	31	0	5515	DEFGHIJKL	49-67
107	L	6	83	43	0	5449	EFGHIJKL	55-67
95	L	6	83	36	0	5443	EFGHIJKL	59-68
CM 101	M	3	74	38	65	5404	FGHIJKL	66-70
82	L	4	81	43	0	5299	GHIJKL	60-68
89	L	5	82	32	0	5290	GHIJKL	49-64

CONTINUED.

TABLE 5. CONTINUED.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
PECOS	M	3	82	45	90	5286	GHIJKL	67-70
116	L	5	85	37	0	5236	HIJKL	55-67
S-201	S	3	82	41	40	5163	IJKL	60-69
101	L	7	85	37	0	5160	IJKL	60-69
91	L	4	81	33	0	5150	JKL	60-70
92	L	6	82	38	0	5119	JKL	53-66
83	L	5	77	32	0	4793	KL	43-64
104	L	6	85	38	0	4614	L	59-68
C.V.		15.2	1.6	3.0	--	7.7		6.6-2.3

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** SUBJECTIVE RATING 1 TO 9, WHERE 1 = EXCELLENT, 9 = POOR.

*** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 6. AGRONOMIC PERFORMANCE OF 1987 UNIFORM RICE NURSERY, GROUP VI. CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
137	L	4	76	37	0	7515	A	62-71
131	L	5	78	39	0	7157	AB	62-70
134	L	4	83	37	0	7137	AB	62-70
123	L	5	77	33	0	6906	ABC	49-68
149	L	4	79	37	0	6881	ABCD	61-68
139	M	3	91	47	0	6751	ABCDE	64-68
152	L	3	81	37	0	6719	ABCDE	56-70
128	L	4	77	35	0	6640	ABCDE	57-69
124	L	4	85	47	0	6598	ABCDEF	57-68
130	L	4	88	51	25	6551	ABCDEFG	61-68
142	L	3	83	44	0	6546	ABCDEFG	49-66
136	L	4	84	40	0	6504	ABCDEFG	56-70
BRAZOS	M	4	85	45	90	6393	ABCDEFGH	65-71
147	L	6	86	45	0	6338	ABCDEFGH	53-69
138	L	5	80	38	0	6235	BCDEFGHI	57-67
148	L	5	80	43	0	6148	BCDEFGHI	59-71
122	L	4	84	44	0	6114	BCDEFGHI	48-70
129	L	5	82	38	0	6079	BCDEFGHI	62-69
126	L	5	81	36	0	6032	BCDEFGHI	59-69
151	L	5	85	48	5	6031	BCDEFGHI	56-68
133	L	5	86	45	35	6026	BCDEFGHI	57-69
127	L	5	86	47	20	6009	BCDEFGHI	60-68
141	L	5	79	45	5	5971	BCDEFGHI	59-67
153	L	5	88	37	0	5950	BCDEFGHI	54-69
121	L	4	80	44	0	5878	CDEFGHI	63-69
144	L	4	82	35	0	5860	CDEFGHI	56-67
125	L	5	76	36	0	5828	CDEFGHI	56-69
143	L	3	78	36	0	5713	CDEFGHI	63-70
132	L	6	83	36	0	5709	CDEFGHI	62-68
NEWREX	L	4	77	46	5	5681	DEFGHI	58-68
NATO	M	4	86	56	60	5546	EFGHI	68-70
135	L	6	82	38	0	5535	EFGHI	56-69

CONTINUED.

TABLE 6. CONTINUED.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
146	L	3	76	35	0	5401	FGHI	60-70
145	L	6	80	39	0	5376	GHI	60-68
140	L	4	79	39	0	5371	GHI	60-68
154	L	4	86	42	0	5338	GHI	59-67
150	L	8	92	32	0	5192	HI	52-68
155	L	5	89	47	30	5063	I	61-68
DELLA	L	5	88	56	85	3760	J	62-69
156	L	5	75	34	0	3608	J	46-67
C.V.		11.3	1.5	3.3	--	8.2		3.3-1.1

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** SUBJECTIVE RATING 1 TO 9, WHERE 1 = EXCELLENT, 9 = POOR.

*** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 7. AGRONOMIC PERFORMANCE OF 1987 UNIFORM RICE NURSERY, GROUP VII. CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
165	L	5	82	40	0	7405	A	62-69
GUI CHOW	M	4	92	45	90	7340	AB	53-70
174	L	4	83	39	0	7200	ABC	63-72
186	L	4	78	38	0	7179	ABC	56-67
185	L	4	84	47	15	7125	ABC	64-69
170	L	5	86	46	0	7063	ABCD	60-70
177	L	5	85	40	0	7043	ABCD	64-69
171	L	6	88	38	0	6970	ABCD	64-70
168	L	5	84	37	0	6877	ABCDE	64-70
166	L	6	83	36	0	6876	ABCDE	64-71
173	L	4	90	44	0	6852	ABCDE	56-69
195	L	5	93	37	0	6781	ABCDEF	61-71
194	L	4	85	49	15	6722	ABCDEF	62-68
193	L	4	79	42	0	6585	ABCDEFG	52-65
175	L	7	84	39	0	6532	ABCDEFG	60-68
161	L	5	88	48	0	6523	ABCDEFG	62-68
182	L	4	91	45	0	6512	ABCDEFG	59-63
187	L	4	77	37	0	6435	ABCDEFG	60-68
191	L	4	83	43	0	6359	ABCDEFG	60-70
164	L	4	91	52	5	6327	ABCDEFG	63-68
167	L	3	83	47	10	6274	ABCDEFGH	57-68
188	L	4	93	50	0	6257	ABCDEFGH	57-69
163	L	6	82	34	0	6190	ABCDEFGH	59-70
NORTAI	S	5	96	47	60	6184	ABCDEFGH	65-70
162	L	4	83	35	0	6153	BCDEFGH	64-71
179	L	5	90	48	20	6105	CDEFGH	58-69
IRGA 409	L	2	92	46	90	6104	CDEFGH	62-69
183	L	3	84	40	0	6082	CDEFGH	54-67
176	L	6	92	44	0	6072	CDEFGH	58-67
169	L	8	89	41	0	6060	CDEFGH	62-68
196	L	6	92	36	0	6045	CDEFGH	56-70
181	L	5	82	40	0	6010	CDEFGH	63-69

CONTINUED.

TABLE 7. CONTINUED.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
190	L	7	93	39	0	5890	DEFGHI	55-66
A-301	L	5	84	41	0	5710	EFGHI	55-69
184	L	6	85	38	0	5662	EFGHI	62-69
189	L	4	79	37	0	5618	FGHI	61-69
180	L	4	82	42	0	5615	FGHI	50-66
178	L	6	82	39	5	5383	GHI	53-64
172	L	8	85	38	0	5076	HI	64-68
192	L	4	91	51	90	3776	I	50-69
C.V.		11.6	1.7	2.9	--	7.9		3.8-2.0

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** SUBJECTIVE RATING 1 TO 9, WHERE 1 = EXCELLENT, 9 = POOR.

*** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

entries yielded relatively well in several groups (e.g., entries 2, 21, 25, 28, 42, 45, 68, 65, 106, 137, 131, 134, 165, 174, and 186).

COMMERCIAL VARIETY TESTS

Description. The breeding program annually conducts yield trials on commercial rice varieties grown in Louisiana. Included in the test are the major commercial varieties and advanced experimentals in the final stages of testing before release from the cooperating public and the private breeding programs. This test supplies comparative information on adaptation and performance of the varieties and experimentals.

Experimental design. The commercial variety test contained 29 entries divided in two maturity groups. The experimental design was a randomized complete block with four replications. The test was grown at three locations, the Rice Research Station (RRS), Crowley, LA; the Northeast Research Station (NRS), St. Joseph, LA; and the Macon Ridge Research Station (MR), Winnsboro, LA. Tests were conducted at NRS and MR under the supervision of Dr. M. Milam. The entries 87AS5510, 87AS3530, and 85AS3058 are from the Alexandria Seed Company, Alexandria, LA. RAX 2003 and RAX 2009 are F₁ hybrids from the Ring-Around Seed Company, Plainview, TX. Entries V7713, V7835, V7955, V4716, and 'CB801' were from RiceTec, Alvin, TX.

Agronomic practices. All entries were drill seeded at 100 lb/A except RAX 2003 and RAX 2009 which was seeded at 50 lb/A. At the RRS, preplant fertilizer was applied and incorporated at a rate of 60-60-60 lb/A total NPK with 100 lb/A of N as ammonium sulfate applied pre-flood. Entries were seeded April 2, 1987, flushed, and a permanent flood was applied as soon as seedlings were tall enough for a shallow flood. Propanil (3 lb/A), Londax (1 oz/A), and carbofuran (20 lb/A) were applied for weed and rice water weevil control. Plots consisted of seven 8-in rows, 16 ft in length. At harvest, plots were trimmed to 12 ft in length and the entire plot harvested with a small plot combine. Harvested samples were dried to approximately 12% moisture in a sack drier. All yields are reported at 12% moisture and are means of four replications. A small sample was taken from the ends of each plot and dried to 12% moisture for milling.

At NRS, the test was planted April 24, 1987 and 120 lb N/A was applied pre-flood. A propanil (3 qt/A) Bolero (3 pt/A) tank mix was applied for weed control. The entire plot (5 x 20') was harvested at maturity, yield determined, and reported as means of four replications at 12% moisture. At MR, the test was planted on April 21, 1987. 0-60-60 lb NPK/A was preplant incorporated and 120 lb/A of N was applied pre-flood. Herbicides included two applications of propanil (2 qt/A and 3 qt/A). Harvest, plot size, and yield determination was identical to the NRS location.

Comments. Performance results for the 1987 commercial variety tests are summarized in Tables 8 to 13. Some pest damage occurred at the RRS in the plots of the 87AS3510, V7713, Mercury, and V4716. Yield estimates were adjusted to try to correct for the damage. Blast was severe on V7835, V7713, and Newbonnet. Bird feeding damage occurred in the very early group at NRS, and the CV's for yield were large in both maturity groups. Bird damage also occurred on 87AS3510 and V7713 at the MR location.

TABLE 8. AGRONOMIC PERFORMANCE OF 1987 COMMERCIAL VARIETY TESTS, GROUP VIII. CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
RAX2009	L	6	85	40	40	8181	A	28-68
RAX2003	L	5	84	41	40	8092	A	42-69
L-202	L	4	85	36	0	6073	B	51-66
SKYBONNET	L	5	91	48	0	5973	B	60-68
8602619	L	6	91	38	0	5877	B	55-67
TEBONNET	L	4	87	51	0	5780	B	55-67
LABELLE	L	5	83	49	5	5352	BC	58-67
V7955	L	5	83	38	0	4484	CD	45-66
BOND	L	4	85	44	3	4302	D	48-64
V7835	L	5	89	42	0	4138	D	42-61
V7713	L	5	77	37	0	3919	D	51-66
87AS3510	L	4	73	45	15	3826	D	57-66
C.V.		10.7	1.5	2.0	--	12.4		11.0-3.1

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** SUBJECTIVE RATING 1 TO 9, WHERE 1 = EXCELLENT, 9 = POOR.

*** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 9. AGRONOMIC PERFORMANCE OF 1987 COMMERCIAL VARIETY TESTS, GROUP IX. CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
RICO 1	M	7	99	44	0	8210	A	70-74
8602606	L	6	96	38	0	7497	B	58-68
LEMONT	L	6	98	36	0	7068	BC	64-70
MARS	M	5	96	46	0	6719	CD	68-71
CB801	L	8	102	35	0	6684	CDE	61-70
TORO-2	L	5	95	42	0	6571	CDEF	65-71
L18502201	L	7	96	37	0	6515	DEFG	61-70
MERCURY	M	5	94	39	0	6468	DEFGH	67-71
GULFMONT	L	6	96	37	0	6315	DEFGH	58-67
V4716	M	5	94	37	0	6157	EFGH	69-71
REXMONT	L	7	94	36	0	6095	FGH	53-65
85AS3058	M	6	93	43	5	6047	FGH	62-69
L18502203	L	7	95	35	0	6019	GH	62-69
87AS3530	L	5	92	33	0	5944	HI	56-70
DLLAX2	L	6	101	45	0	5474	IJ	60-69
DLLA	L	6	100	55	10	5198	JK	59-68
NEWBONNET	L	6	99	42	0	4789	K	47-64
C.V.		9.5	0.8	2.4		5.3		4.1-1.3

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** SUBJECTIVE RATING 1 TO 9, WHERE 1 = EXCELLENT, 9 = POOR.

*** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 10. AGRONOMIC PERFORMANCE OF 1987 COMMERCIAL VARIETY TESTS GROUP VIII.
SAINT JOSEPH, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HGT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **
L-202	L	89	29	8	7563	A
RAX2003	L	87	32	15	7240	A
V7955	L	88	33	3	6697	AB
8602619	L	91	30	0	5998	ABC
V7835	L	91	37	15	5821	ABC
TEBONNET	L	88	46	3	5210	BCD
RAX2009	L	87	32	25	4977	BCD
SKYBONNET	L	92	40	8	4965	BCD
BOND	L	90	41	0	4574	CD
LABELLE	L	88	47	8	3905	D
V7713	L	79	36	8	1943	E
87AS3510	L	72	38	0	1925	E
C.V.		2.7	6.8	--	2.8	

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 11. AGRONOMIC PERFORMANCE OF 1987 COMMERCIAL VARIETY TESTS GROUP IX.
SAINT JOSEPH, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **
NEWBONNET	L	95	39	0	7616	A
TORO-2	L	93	39	0	7178	AB
RICO 1	M	94	36	27	6922	ABC
8602606	L	92	31	0	6840	ABC
L18502201	L	94	30	0	6692	ABCD
LEMONT	L	95	29	0	6663	ABCD
MERCURY	M	92	32	3	6522	ABCDE
GULFMONT	L	94	29	0	6415	ABCDE
V4716	M	93	30	0	6384	ABCDE
REXMONT	L	92	28	5	6294	ABCDE
87AS3530	L	91	28	0	6153	ABCDE
CB801	L	101	31	0	5969	ABCDE
MARS	M	92	40	10	5568	BCDE
DLLAX2	L	95	38	0	5494	BCDE
L18502203	L	94	27	0	5364	CDE
DLLA	L	93	48	13	5115	DE
85AS3058	M	89	35	15	4906	E
C.V.		1.2	5.3	--	16.2	

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 12. AGRONOMIC PERFORMANCE OF 1987 COMMERCIAL VARIETY TESTS GROUP VIII.
MACON RIDGE, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **
RAX2009	L	85	31	20	6538	A
V7835	L	96	32	0	6208	AB
L-202	L	88	27	0	5796	BC
RAX2003	L	85	31	15	5764	BC
V7955	L	92	31	0	5524	C
TEBONNET	L	97	38	0	5519	C
BOND	L	91	32	0	5318	CD
8602619	L	97	30	0	4915	DE
SKYBONNET	L	96	33	0	4674	E
LABELLE	L	92	36	0	4459	E
V7713	L	84	31	0	2800	F
87AS3510	L	76	35	0	1848	G
C.V.		1.6	2.7		7.2	

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 13. AGRONOMIC PERFORMANCE OF 1987 COMMERCIAL VARIETY TESTS GROUP IX.
MACON RIDGE, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **
RICO 1	M	97	30	0	7023	A
NEWBONNET	L	99	34	0	6391	AB
8602606	L	98	31	0	6269	AB
MARS	M	97	34	0	6160	AB
V4716	M	98	28	0	5998	BC
TORO-2	L	97	31	0	5958	BC
LEMONT	L	99	28	0	5906	BCD
GULFMONT	L	98	29	0	5714	BCDE
CB801	L	100	29	0	5699	BCDE
DLLA	L	98	40	0	5578	BCDEF
REXMONT	L	97	30	0	5377	BCDEF
L18502203	L	99	28	0	5057	CDEF
L18502201	L	100	29	0	5028	CDEF
87AS3530	L	97	25	0	4941	DEF
DELLA X2	L	98	33	0	4762	EF
85AS3058	M	91	29	0	4654	F
MERCURY	M	93	27	0	4616	F
C.V.		2.1	4.9		10.8	

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

ADVANCED YIELD TESTS

Description. On-farm yield testing of advanced experimental lines from the rice breeding program was initiated in 1984. The goal of this activity is to sample additional environments in yield testing new promising selections from the breeding program. These additional yield evaluations are needed to identify the performance characteristics, strengths, and weaknesses of the test entries. Multi-location and multi-year testing is essential to provide the information needed to make decisions on releasing new varieties.

Experimental design. Advanced yield tests were conducted at five locations in Louisiana in cooperation with commercial growers and the RRS rice fertilization and entomology projects. Four very early maturing entries were tested at RRS, Lake Arthur, and Rapides parishes. Some selected early entries were also tested at the Morehouse and East Carroll locations. Plot sizes were 4.75 x 22 at RRS and approximately 7 x 25' at all other locations. Experimental design was a randomized complete block with four replications. The selected early entries tested at Morehouse and East Carroll parishes contained only three replications.

Agronomic practices. Rice was water-seeded (150 lb/A) at Lake Arthur, Rapides, and Morehouse locations and drill-seeded (100 lb/A) at the RRS and East Carroll locations. Fertilization included 120-60-60 lb/A NPK preplant pre-flood at Lake Arthur, Rapides, and Morehouse. A Basal NPK application 60-60-60 was applied at RRS preplant and 100 lb/A N was applied pre-flood. At the East Carroll location 120 lb/A N was applied pre-flood. Topdressings of 20 and 30 lb/A N was applied at RRS and Rapides parishes, respectively. Weed, insect, and disease pesticides included propanil (4 lb/A), Londax (1 oz/A), carbofuran (20 lb/A), Tilt (8 oz/A), Rovral (1 lb/A) at Lake Arthur; propanil (4 lb/A), carbofuran (20 lb/A), and Benelate (1 lb/A) at Morehouse; propanil + biominal (4 lb/A + $\frac{1}{2}$ pt/A), Basagran (1 $\frac{1}{2}$ pt/A), carbofuran (20 lb/A), and Benelate (1 lb/A) at East Carroll; propanil (3 lb/A), propanil + Bolero (3 lb/A + 3 pt/A), carbofuran (20 lb/A), and Basagran (2 pt/A) at RRS; and propanil + Butril (3.7 lb/A + 1 pt/A), carbofuran (20 lb/A), Londax (0.6 oz/A), Benelate (1 lb/A), and methyl parathion ($\frac{1}{2}$ lb/A).

Comments: Tables 14 through 21 contains the mean values for the agronomic characteristic measured. Delayed planting and cool fall temperatures prevented collection of second crop data on entries at Lake Arthur. Only the medium-grain entries produced acceptable second crop. Milling yields in Table 14 were taken and harvested and early maturing entries were over ripe producing low head rice yields. Table 15 shows lodging, due to fill soil and high N levels, was a severe problem even on the semidwarf entries. Bird feeding was responsible for the low yield of entries 219 and 204 at Morehouse (Table 16). Milling samples at Lake Providence were available for only one replication so no statistical calculations were conducted on those characteristics (Table 17). Blast was present at RRS. The low yields of Mercury was attributed to blast and possibly some damage from white-tip nematodes (Table 19). The water-seeded planting method used at Rapides was very successful inspite of the late seeding date. The low yield performance of Mercury appeared to be the result of sheath rot (Table 21).

TABLE 14. AGRONOMIC PERFORMANCE OF 1987 ADVANCED YIELD TEST, EARLY GROUP. LAKE ARTHUR, LA.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
206	L	4	74	35	0	7885	A	46-66
201	L	5	77	34	0	7499	AB	53-68
209	L	4	76	35	0	7483	AB	48-67
203	L	5	76	33	0	7467	AB	55-68
212	L	4	75	34	0	7441	AB	55-69
204	L	4	75	36	0	7332	B	54-68
210	L	3	77	36	0	7306	B	51-68
MERCURY	M	2	76	36	0	7252	BC	62-70
205	L	3	74	35	0	7196	BC	50-68
207	L	3	75	34	0	7092	BC	42-66
208	L	4	80	34	0	7045	BC	46-66
211	L	4	78	35	0	6767	C	56-69
LEMONT	L	5	80	34	0	6760	C	57-69
202	L	5	77	35	0	6748	C	52-69
MARS	M	3	82	44	0	5542	D	63-69
DELLA X2	L	6	84	43	25	4728	E	50-68
C.V.		11.0	1.1	3.4		4.7		3.1-0.9

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** SUBJECTIVE RATING 1 TO 9, WHERE 1 = EXCELLENT, 9 = POOR.

*** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 15. AGRONOMIC PERFORMANCE OF 1987 ADVANCED YIELD TEST, VERY EARLY GROUP. LAKE ARTHUR, LA.

1987 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
217	L	4	77	37	0	7627	A	53-68
219	L	3	76	39	65	6578	B	58-69
218	L	4	75	38	57	6554	B	54-68
TEBONNET	L	4	76	49	90	5061	C	60-69
C.V.		7.5	1.2	2.0		9.6		3.0-0.8

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** SUBJECTIVE RATING 1 TO 9, WHERE 1 = EXCELLENT, 9 = POOR.

*** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 16. AGRONOMIC PERFORMANCE OF 1987 ADVANCED YIELD TEST, EARLY GROUP.
MOREHOUSE, LA.

1987 ENTRY	GRAIN TYPE	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	YIELD (LB/A @12%)	DUNCAN'S TEST *	MILLING % (WHL-TOT)
209	L	79	29	8968	A	61-70
210	L	79	30	8620	AB	59-69
MERCURY	M	79	30	8192	AB	68-72
211	L	78	29	8144	AB	58-70
205	L	75	28	7922	AB	61-70
201	L	81	28	7779	AB	62-70
206	L	75	26	7556	BC	61-71
208	L	79	28	7556	BC	60-69
207	L	77	27	7459	BC	55-68
204	L	75	29	7258	BC	58-69
203	L	76	26	6365	C	61-69
219	L	74	28	4881	D	63-70
C.V.	1.1	3.0	8.8			3.8-1.4

* NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT
THE 0.05 LEVEL.

TABLE 17. AGRONOMIC PERFORMANCE OF 1987 ADVANCED YIELD TEST, EARLY GROUP.
LAKE PROVIDENCE, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	YIELD (LB/A @12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
208	L	95	32	8611	A	65-71
204	L	96	37	8230	AB	68-72
209	L	97	33	7841	ABC	64-72
207	L	94	34	7831	ABC	61-70
211	L	100	37	7715	BC	65-70
206	L	95	33	7664	BC	68-71
210	L	99	36	7461	BC	65-70
205	L	96	34	7192	C	66-71
C.V.		1.3	5.4	5.5		---

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT
THE 0.05 LEVEL.

TABLE 18. AGRONOMIC PERFORMANCE OF 1987 ADVANCED YIELD TEST, VERY EARLY GROUP. LAKE PROVIDENCE, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
219	L	93	32	0	8178	A	67-72
TEBONNET	L	94	45	13	8040	A	64-71
218	L	92	32	0	7698	A	62-71
217	L	93	30	0	7181	A	65-71
C.V.		1.6	3.0	--	8.0		2.0-0.8

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 19. AGRONOMIC PERFORMANCE OF 1987 ADVANCED YIELD TEST, EARLY GROUP. RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY		DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST *	MILLING % (WHL-TOT)
MARS	M	76	48	3	7607	A	64-69
211	L	75	39	0	7538	A	63-70
210	L	75	37	0	7355	AB	61-69
204	L	72	38	0	7025	BC	60-70
LEMONT	L	77	36	0	7005	BCD	60-70
202	L	74	39	0	6952	BCD	57-70
206	L	72	35	0	6896	CDE	57-70
201	L	75	36	0	6870	CDE	53-70
208	L	75	37	0	6759	CDEF	55-68
212	L	78	35	0	6699	CDEF	58-71
207	L	72	36	0	6564	DEF	52-68
205	L	72	36	0	6459	EFG	61-70
203	L	74	34	0	6379	FG	55-70
209	L	74	37	0	6104	GH	46-68
DELLA X2	L	81	45	0	5738	HI	58-68
MERCURY	M	74	38	0	5608	I	56-69
C.V.		0.9	3.7		4.1		5.3-1.0

* NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 20. AGRONOMIC PERFORMANCE OF 1987 ADVANCED YIELD TEST, VERY EARLY GROUP.
RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **	MILLING (WHL-TOT)
TEBONNET	L	71	52	15	7265	A	59-71
219	L	71	38	0	7001	A	63-71
217	L	71	37	0	6476	B	60-70
218	L	71	38	0	6373	B	57-70
C.V.		0.7	3.0		3.5		2.9-0.7

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 21. AGRONOMIC PERFORMANCE OF 1987 ADVANCED YIELD TEST, EARLY GROUP.
RAPIDES, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **
211	L	76	40	17	7043	A
209	L	77	37	0	6861	A
208	L	77	36	0	6848	A
207	L	75	37	0	6723	AB
LEMONT	L	80	37	0	6692	AB
206	L	76	35	0	6603	AB
212	L	78	37	0	6602	AB
203	L	78	36	0	6554	AB
204	L	76	38	0	6538	AB
201	L	79	36	0	6535	AB
210	L	79	39	0	6521	AB
205	L	76	37	0	6466	AB
202	L	79	38	5	6464	AB
MARS	M	76	44	85	6152	B
DELLA X2	L	78	40	8	5598	C
MERCURY	M	75	38	35	5232	C
C.V.		0.9	2.9		5.8	

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

PRELIMINARY YIELD TESTS

Description. The preliminary yield tests provide the first stage of replicated testing of promising experimental lines in field plots. Many of those lines are discarded before harvest or after laboratory evaluation. The more promising entries will be reselected and advanced for further testing.

Experimental design. The preliminary yield test used a randomized complete block design with two replications. The 230 entries were grouped into ten groups by maturity and grain type. Each plot consisted of seven 8-in rows 16 ft in length. At harvest, the plots were trimmed to 12 ft, and all seven rows were harvested with a small plot combine. Samples were dried to approximately 12% moisture and yields determined and reported at a 12% moisture basis. Milling samples were obtained from the seed harvested for yield.

Agronomic practices. Entries were drill-seeded at 100 lb/A April 27, 1986. Preplant fertilizer was applied and incorporated at a rate of 60-60-60 lb/A total NPK and 100 lb N/A applied preflood. The entries were flushed to initiate germination and a permanent flood was applied as soon as seedlings were tall enough for a shallow flood. Propanil (3 lb/A), Bolero (40 lb/A), Basagran, and carbofuran (20 lb/A) were applied for weed and insect control, respectively.

Comments. Performance of the 1986 preliminary yield entries are summarized in Tables 22 through 31. Many of the entries out-performed the check varieties. Blast significantly reduced plot and milling yields in the medium-grain tests. Many of these selections are being considered for the Advanced Yield and Cooperative Uniform Regional Rice Nursery tests in 1988. All these lines still show considerable segregation. The best are being advanced, reselected, and purified.

TABLE 22. AGRONOMIC PERFORMANCE OF 1987 PRELIMINARY YIELD TESTS, GROUP XI,
RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
521	L	80	36	6514	A	63-71
TEBONNET	L	76	49	6491	AB	61-71
517	L	76	35	6428	AB	61-72
509	L	73	34	6322	ABC	61-71
510	L	73	37	6273	ABC	57-70
518	L	74	39	6225	ABC	62-71
513	L	76	37	6188	ABCD	61-71
514	L	79	39	6134	ABCD	63-70
516	L	78	34	5986	ABCDE	51-71
520	L	76	36	5882	ABCDE	64-71
511	L	74	36	5870	ABCDE	57-70
519	L	77	38	5716	ABCDE	54-68
508	L	76	35	5716	ABCDE	52-71
504	L	75	35	5712	ABCDE	61-71
515	L	79	36	5607	ABCDE	63-71
512	L	79	35	5584	ABCDE	55-71
507	L	76	36	5582	ABCDE	54-71
522	L	85	33	5459	BCDEF	40-67
501	L	76	36	5446	BCDEF	58-70
523	L	76	34	5321	CDEF	56-70
502	L	77	39	5314	CDEF	48-70
503	L	78	36	5173	DEF	55-70
524	L	76	35	5173	DEF	34-69
506	L	76	35	5051	EF	60-70
504	L	74	34	4487	F	47-71
C.V.		0.8	3.1	7.4		2.6-0.5

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT
THE 0.05 LEVEL.

TABLE 23. AGRONOMIC PERFORMANCE OF 1987 PRELIMINARY YIELD TESTS, GROUP XII, RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
535	L	76	37	6561	A	60-70
542	L	76	38	6489	A	61-71
537	L	76	36	6451	AB	58-71
TEBONNET	L	74	50	6416	ABC	61-72
L-202	L	72	37	6222	ABCD	57-69
548	L	76	42	6176	ABCDE	46-71
530	L	77	40	6087	ABCDEF	61-71
545	L	75	50	6066	ABCDEF	58-69
526	L	75	41	5969	ABCDEFG	44-71
543	L	76	39	5966	ABCDEFG	66-71
544	L	76	38	5920	ABCDEFGH	63-69
527	L	76	39	5768	BCDEFGHI	42-71
547	L	76	42	5751	CDEFGHIJ	47-70
534	L	72	38	5684	DEFGHIJ	54-70
532	L	77	37	5664	DEFGHIJ	54-71
539	L	76	38	5510	EFGHIJ	63-70
538	L	77	35	5447	FGHIJ	49-72
531	L	78	36	5445	FGHIJ	58-70
528	L	76	39	5443	FGHIJ	62-70
529	L	72	39	5427	FGHIJ	65-71
546	L	74	34	5340	GHIJ	62-72
540	L	76	35	5252	HIJ	39-73
541	L	75	37	5209	IJ	42-72
536	L	76	32	5065	J	63-71
533	L	72	40	5061	J	58-69
C.V.		0.8	2.5	5.0		3.6-0.6

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 24. AGRONOMIC PERFORMANCE OF 1987 PRELIMINARY YIELD TESTS, GROUP XIII, RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
568	L	75	38	0	6833	A	62-73
572	L	81	36	0	6827	A	59-69
L-202	L	72	38	0	6812	A	58-69
569	L	76	39	0	6740	AB	66-71
555	L	73	42	0	6716	AB	59-70
554	L	73	43	0	6582	ABC	59-69
TEBONNET	L	74	50	0	6565	ABCD	62-70
565	L	81	36	0	6441	ABCDE	65-71
566	L	75	42	0	6420	ABCDE	61-70
560	L	72	37	0	6391	ABCDE	58-70
558	L	78	42	0	6321	ABCDE	64-72
567	L	76	34	0	6298	ABCDEF	63-71
563	L	73	39	0	6203	ABCDEFG	65-72
570	L	75	34	0	6196	ABCDEFG	57-70
571	L	75	33	0	6156	BCDEFG	57-70
551	L	76	42	0	6152	BCDEFG	61-73
553	L	72	40	0	6029	CDEFG	49-70
561	L	73	35	0	5993	CDEFG	62-70
556	L	72	42	0	5980	CDEFG	63-69
557	L	76	37	0	5919	DEFG	54-71
552	L	72	38	0	5833	EFG	49-72
LABELLE	L	73	49	5	5822	EFG	64-71
559	L	76	37	0	5658	FG	64-70
562	L	74	39	0	5597	G	65-72
564	L	76	31	0	4660	H	61-73
C.V.		0.8	3.2		4.3		2.2-0.3

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 25. AGRONOMIC PERFORMANCE OF 1987 PERLIMINARY YIELD TESTS, GROUP XIV,
RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
583	M	80	39	0	6831		62-71
580	M	74	40	0	6485		55-70
576	M	80	38	0	6221		54-70
578	M	78	33	0	6165		55-70
579	M	79	34	0	6077		54-71
585	M	72	38	0	5902		58-71
587	M	76	43	0	5816		57-72
586	M	75	37	0	5797		61-70
577	M	79	35	0	5796		58-70
581	M	76	45	0	5763		61-72
582	M	76	34	0	5730		55-70
589	M	74	41	0	5637		53-69
588	M	74	42	30	5510		49-71
584	M	79	39	0	4870		54-68
C.V.		0.7	3.3		10.4	NS	13.9-2.8

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT
THE 0.05 LEVEL.

TABLE 26. AGRONOMIC PERFORMANCE OF 1987 PRELIMINARY YIELD TESTS, GROUP XV,
RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
609	L	79	43	7440	A	50-68
607	L	80	41	7225	AB	48-67
604	L	79	39	7187	AB	57-69
608	L	80	42	7158	AB	50-67
596	L	81	38	7037	ABC	49-72
612	L	81	35	7034	ABC	58-70
LEMONT	L	82	37	6860	ABCD	58-72
601	L	77	37	6781	ABCD	49-72
605	L	77	41	6725	BCDE	47-71
GULFMONT	L	80	38	6563	BCDEFG	62-71
603	L	78	36	6553	BCDEFG	64-70
594	L	77	35	6549	BCDEFG	59-69
8502201	L	79	37	6474	CDEFGH	57-71
592	L	78	35	6401	CDEFGH	55-70
610	L	78	38	6359	CDEFGHI	63-70
600	L	81	32	6329	DEFGHI	47-72
606	L	80	41	6262	DEFGHI	43-70
599	L	77	35	6202	DEFGHI	44-68
591	L	80	39	6176	DEFGHI	58-71
598	L	79	38	6101	EFGHI	60-70
593	L	82	35	6086	FGHI	57-70
597	L	75	39	5921	GHIJ	59-70
611	L	80	35	5861	HIJ	56-72
595	L	78	36	5714	IJ	52-69
602	L	75	32	5407	J	66-72
C.V.		1.9	3.4	4.4		2.8-1.0

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT
THE 0.05 LEVEL.

TABLE 27. AGRONOMIC PERFORMANCE OF 1987 PERLIMINARY YIELD TESTS, GROUP XVI,
RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
624	L	81	36	7201	A	63-73
8502203	L	78	36	7168	AB	62-72
632	L	80	39	6983	ABC	64-73
621	L	78	36	6895	ABCD	56-74
623	L	79	36	6682	ABCDE	62-72
635	L	78	41	6670	ABCDE	64-72
634	L	79	39	6645	ABCDE	66-71
633	L	79	40	6626	ABCDE	53-74
620	L	76	42	6616	ABCDE	62-72
628	L	77	37	6563	ABCDE	50-72
627	L	78	44	6550	ABCDE	56-72
626	L	78	43	6468	ABCDE	57-73
630	L	81	41	6462	ABCDE	55-73
GULFMONT	L	82	38	6451	ABCDE	63-71
LEMONT	L	85	38	6406	ABCDE	64-72
631	L	79	39	6322	ABCDE	59-74
636	L	82	36	6283	BCDE	68-73
629	L	78	37	6268	BCDE	49-71
618	L	79	36	6191	CDE	57-74
625	L	73	43	6123	CDE	55-72
619	L	76	48	6030	DE	56-73
637	L	77	36	6017	DE	59-72
622	L	81	35	5933	E	60-73
616	L	81	37	5850	E	63-73
617	L	83	31	4464	F	63-74
C.V.		1.6	3.2	5.9		4.2-0.8

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT
THE 0.05 LEVEL.

TABLE 28. AGRONOMIC PERFORMANCE OF 1987 PRELIMINARY YIELD TESTS, GROUP XVII,
RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
643	L	76	37	7315	A	56-70
649	L	83	35	7111	AB	65-72
646	L	82	38	7092	ABC	67-72
650	L	81	37	6921	ABCD	54-70
GULFMONT	L	80	37	6915	ABCD	55-71
645	L	78	38	6870	ABCD	66-72
LEMONT	L	83	36	6862	ABCD	49-73
647	L	78	39	6853	ABCD	55-73
652	L	81	36	6802	ABCDE	43-72
641	L	76	36	6779	ABCDE	51-73
657	L	80	37	6759	ABCDE	57-71
653	L	80	36	6736	ABCDE	48-71
659	L	77	39	6697	ABCDE	58-72
661	L	81	37	6693	ABCDE	54-71
651	L	78	35	6664	ABCDE	53-72
656	L	76	36	6586	ABCDE	50-73
648	L	76	34	6534	ABCDE	60-73
658	L	81	38	6520	ABCDE	51-72
642	L	76	35	6350	BCDEF	53-72
654	L	79	34	6214	CDEF	51-72
655	L	76	34	6201	DEF	46-73
644	L	76	35	5958	EFG	62-72
660	L	76	38	5679	FGH	51-70
663	L	80	33	5310	GH	33-73
662	L	78	33	5051	H	41-74
C.V.		1.8	2.6	5.5		3.8-0.8

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT
THE 0.05 LEVEL.

TABLE 29. AGRONOMIC PERFORMANCE OF 1987 PRELIMINARY YIELD TESTS, GROUP XVIII, RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
682	L	81	37	7770	A	58-72
686	L	78	37	7498	AB	49-72
683	L	81	37	7483	ABC	58-72
678	L	78	39	7224	ABCD	59-73
668	L	79	42	7179	ABCDE	47-73
685	L	83	36	7083	ABCDE	66-72
671	L	78	37	7071	BCDE	65-73
673	L	80	36	7066	BCDE	61-71
670	L	76	38	7044	BCDEF	61-72
669	L	77	40	6993	BCDEF	54-71
675	L	80	35	6900	BCDEF	60-72
LEMONT	L	83	37	6835	BCDEF	56-72
687	L	77	36	6769	CDEFG	56-72
GULFMONT	L	81	38	6754	DEFG	58-71
681	L	85	35	6748	DEFG	57-71
666	L	80	36	6736	DEFG	60-72
688	L	78	37	6705	DEFG	47-71
676	L	78	40	6586	DEFG	48-72
672	L	76	35	6535	DEFG	68-72
677	L	77	37	6487	EFG	37-74
684	L	81	35	6465	EFG	62-73
674	L	75	37	6331	FGH	57-72
667	L	84	38	6064	GHI	61-72
680	L	87	32	5704	HI	55-67
679	L	76	44	5553	I	47-73
C.V.		2.2	3.1	4.4		3.0-0.7

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 30. AGRONOMIC PERFORMANCE OF 1987 PRELIMINARY YIELD TESTS, GROUP XIX, RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	LODGING (%)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
691	L	78	37	0	6590	A	48-72
709	L	78	36	0	6465	AB	41-73
698	L	80	38	0	6463	AB	34-73
707	L	89	43	0	6415	AB	56-68
692	L	79	37	0	6331	AB	40-72
696	L	80	39	0	6287	ABC	48-71
694	L	77	42	0	6272	ABCD	41-70
708	L	89	44	0	6254	ABCDE	52-69
697	L	81	41	0	6165	ABCDE	46-72
695	L	76	40	0	6164	ABCDE	52-71
699	L	90	41	0	6066	ABCDE	52-70
700	L	79	39	0	6020	ABCDEF	35-72
703	L	77	41	0	5997	ABCDEF	33-73
702	L	77	43	0	5960	ABCDEF	37-71
704	L	76	39	0	5945	ABCDEF	34-72
693	L	77	38	0	5921	ABCDEF	38-71
710	L	78	39	0	5907	ABCDEF	37-73
701	L	77	38	0	5751	ABCDEF	45-71
711	L	76	41	0	5707	BCDEF	55-72
DELLA X2	L	88	44	0	5419	CDEF	55-69
705	L	91	40	0	5400	DEF	53-70
706	L	81	40	0	5387	EF	48-72
DELLA	L	86	55	20	5380	EF	52-68
A-30	L	84	40	0	5185	F	52-69
712	L	87	46	0	4313	G	34-66
C.V.		2.2	2.8		6.1		8.2-1.4

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE 0.05 LEVEL.

TABLE 31. AGRONOMIC PERFORMANCE OF 1987 PRELIMINARY YIELD TESTS, GROUP XX,
RICE RESEARCH STATION, CROWLEY, LA.

1987 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HEIGHT (IN)	YIELD (LB/A @ 12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
RICO 1	M	82	45	7756	A	64-73
726	M	88	39	7723	A	62-69
727	M	89	39	7695	A	64-70
724	M	81	40	7198	B	56-71
720	M	80	40	7118	B	55-71
721	M	81	40	7060	B	57-72
MARS	M	81	48	7050	B	54-72
716	M	76	43	7017	B	46-73
725	M	82	41	6998	B	55-71
723	M	82	40	6981	B	54-71
717	M	85	38	6979	B	59-71
719	M	85	39	6728	BC	49-71
722	M	82	39	6469	CD	48-71
718	M	87	39	6036	DE	58-70
MERCURY	M	80	38	5708	E	36-69
C.V.		1.2	3.3	3.0		4.4-0.8

* L = LONG GRAIN, M = MEDIUM GRAIN, S = SHORT, AND I = INTERMEDIATE.

** NUMBERS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT
THE 0.05 LEVEL.

MULTIPLE GENERATION RICE BREEDING NURSERY^{1/2/}

K.S. McKenzie, F. Jodari, A.P. Fabacher, R.J. Guidry,
L.M. White, and C.T. Ramirez^{3/}

INTRODUCTION

Continuing efforts to increase rice production and quality through plant breeding is essential for the maintenance of a prosperous Louisiana rice industry. Genetic potential to elevate yields of adapted Louisiana rice cultivars exists and is being utilized by the current LSU rice breeding program. Sources of resistance to environmental stresses as well as to disease and insect pests are being identified and are available for use in rice breeding programs. Development of high yielding rice cultivars that efficiently utilize plant nutrients, are resistant to pests and lodging, and have good milling and cooking qualities will greatly improve the profitability of rice production in Louisiana.

A major limitation to the speed at which desirable genetic characters can be transferred into adapted lines in inbred crops such as rice, is the number of generations that can be produced per year. For many complex and economically important characters it may require four or more generations before breeding lines have reached a sufficient level of homozygosity to allow even a preliminary evaluation. Production of only one generation of breeding material per year after the initial hybridization makes varietal development a very slow process. The production of two or more generations of breeding material per year decreases the time required to advance breeding lines to the point where they can be evaluated for complex characteristics such as yield, milling quality, and other important varietal characteristics.

A winter nursery is an essential and integral feature of a modern rice breeding program. The nursery allows the production of additional generations of breeding material per year thus hastening the time required to develop new varieties. The winter nursery also permits an opportunity to practice disruptive selection in another environment and the growing of elite selections of germplasm not adapted to the Louisiana environment. The primary purpose and advantages of planting this off-season nursery have been discussed previously (see 1974 La. State Univ. Rice Exp. Rt. 66:32).

- 1/ Cooperative investigations, Louisiana Agricultural Experiment Station, Crowley, LA; University of Puerto Rico Agricultural Experiment Station, Lajas, PR; Texas Agricultural Experiment Station, Beaumont, TX; and Arkansas Agricultural Experiment Station, Stuttgart, AR.
- 2/ This research is supported in part by funds provided by rice producers through the Louisiana Rice Research Board.
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The Agricultural Experiment Stations of Arkansas, Louisiana, Puerto Rico, and Texas have renewed the cooperative agreement to operate a year-round rice nursery on the Puerto Rico Experiment Station located at Lajas for the purpose of advancing and seed increase of breeding lines. This cooperative venture has made possible the expansion of nursery facilities, equipment, and labor and is allowing these rice breeding programs to grow more breeding lines to expedite the development and release of improved rice varieties for the southern United States. Efforts are being made to improve efficiency and address the difficulties that have been experienced in the nursery.

1987-88 ACTIVITIES

The September 25, 1986 nursery planting by Louisiana and Texas was successful and harvested in January 1987. The Louisiana nursery included a seed increase of an experimental semidwarf aromatic line, breeding lines, sheath blight resistant lines provided by the Rice Research Station Genetics and Pathology projects, and somaclonal lines from the Rice Research Tissue Culture project. Harvest was completed in January 1987 and a second planting of an additional 6,000 rows was made by the Louisiana and Texas breeding programs. Approximately 1,200 selections were returned to the Rice Research Station and replanted from the September 1986 nursery. The January 1987 nursery contains 1,500 rows from the Rice Research Station and 1,500 rows replanted from the September 1986 nursery. The Texas nursery was planted in a similar fashion. In May, the January 1987 nursery was harvested and approximately 4,000 selections from that nursery were replanted at the Rice Research Station. This sequence of selection and replanting of the nursery allowed the production of three successive generations in one year. This rapid advancement of breeding material should be beneficial in hastening rice varietal development.

A September 1987 nursery of 9,000 rows was planted by the Louisiana, Texas, and Arkansas breeding programs. Selection, harvest, and replanting of the nursery are scheduled for January 1988.

RICE GENETICS

DEVELOPMENT OF LONG-GRAIN SHEATH BLIGHT RESISTANT GERMPLASM

E.M. Nowick and D.E. Groth

INTRODUCTION

In 1986, progeny lines from the first through fourth backcross of Lemont to Tetep were screened for resistance to sheath blight in replicated field tests. Individual plants were selected from those progeny lines which were significantly more resistant to sheath blight caused by Rhizoctinia solani Kuhn than the susceptible parent Lemont. All selected plants were progeny tested for sheath blight resistance again in 1987 in replicated field tests.

MATERIALS AND METHODS

Individual plants were harvested from the rows which fell into the most resistant category in a Duncan's multiple range test in the 1986 field trials. In addition, any short early plants having disease ratings of 4 or better were harvested and advanced one generation in the winter nursery in Puerto Rico. Individual panicles were harvested from the plant rows in the winter nursery for testing in the F_4 generation.

For those plants selected only on the basis of disease rating, F_3 progeny from individual F_2 plants were drill-seeded into 1 m rows with 25 cm between rows. Each F_3 progeny line was tested in three replicates. Plants were inoculated by spreading infected rice hull mixture on the plants near the water surface at the late-tillering stage. For the plants selected for plant type as well as for resistance, the test was similar except that F_4 panicle rows were planted and separate panicles from F_3 winter nursery rows served as replicates. Rows were rated on a scale of 0-9 where 0 indicated no infection and 9 indicated that the entire plant row was dead.

RESULTS

The mean values of the progeny tests from the selected lines are shown in Table 1. The level of resistance for the selections made on the basis of disease resistance alone were only slightly lower than the ratings for Tetep and were significantly better than Lemont. However, these lines were on the average later and taller than Lemont. For those lines descending from plants selected for plant type, as well as disease resistance, the mean disease rating was only slightly better than Lemont. Individual lines, however, were identified which were early, short, had long grains, and were significantly better than Lemont in disease ratings.

Table 1. Means and standard deviations of DR in field tests of lines selected on the basis of DR only or for semidwarf plant height, early flowering, and DR in backcrosses of Lemont to Tetep. Rice Research Station, Crowley, LA. 1987.^{1/}

	$\bar{x} \pm \text{standard deviation}$		
	Total population	Selected	Selected
	<u>Tested in 1986</u>	<u>for DR only</u>	<u>for plant</u>
		<u>Tested in 1987</u>	<u>type and DR</u>
			<u>Tested in 1987</u>
BC1			
DR	3.6 $\pm$.61	3.11 $\pm$ 1.65	4.8 $\pm$ 1.72
Julian date of heading	206 $\pm$ 11.5	209 $\pm$ 9.58	205 $\pm$ 8.18
Plant height (cm)	88.1 $\pm$ 154	146.7 $\pm$ 26.6	
BC2			
DR	4.13 $\pm$.88	3.16 $\pm$ 2.01	5.94 $\pm$ 1.78
Julian date of heading	203 $\pm$ 5.2	211 $\pm$ 6.22	206 $\pm$ 7.97
Plant height (cm)	77.6 $\pm$ 140	134 $\pm$ 31	
BC3			
DR	4.45 $\pm$.78	3.12 $\pm$ 1.59	5.46 $\pm$ 1.6
Julian date of heading	197 $\pm$ 3.9	208 $\pm$ 5.92	207 $\pm$ 6.38
Plant height (cm)	80 $\pm$ 150	141.6 $\pm$ 26.9	
Lemont			
DR	6.65 $\pm$.92	7.7	5.86 $\pm$ 1.32
Julian date of heading	198 $\pm$ 64	202	202 $\pm$ 0
Plant height (cm)	620 $\pm$ 25	95.2	
Tetep			
DR	2.15 $\pm$.35	2.33	1.23 $\pm$.43
Julian date of heading	206 $\pm$.71	212	212 $\pm$ 1.12
Plant height (cm)	119.7 $\pm$ 14	162	

^{1/} DR = disease rating of plants rated visually on a 0-9 scale.

GENETIC VARIABILITY AMONG WILD SPECIES OF ORYZA NATIVE TO THE AMAZON BASIN

E.M. Nowick

INTRODUCTION

Despite considerable efforts in screening the world collection of rice for resistance to rice water weevils, no high levels of resistance have been identified. The insect is native to North and South America. For this reason, a collection trip was made to the lower Amazon basin to collect wild species of Oryza native to the region. As the wild species of Oryza native to South America are exposed to the insect, it is hoped that some level of resistance will have evolved. Thirty-three populations of relatives of wild rice were collected and are now being grown in quarantine. There is some question of the relationship of the South American species of Oryza to the Asian species and to cultivated rice, particularly whether O. glumaepatula which is closely related to O. sativa may not be a recent introduction to South America and a variant of the Asian wild rices. Because the value of O. glumaepatula as a unique source of germplasm may depend on this question, Isozyme polymorphisms within the collected populations of O. glumaepatula and its Asian relatives were determined.

MATERIALS AND METHODS

The plants sampled included 16 populations of O. glumaepatula collected between Belem and Manaus in the lower Amazon basin, four accessions of O. meridionalis from Australian, and 44 accessions of Asian AA genome species.

Young leaf tissue was collected from seedlings at the 5-leaf growth stage. Tissue sampling and electrophoretic procedures were performed according to the method of Morden et. al. (In Press). Eight enzyme systems representing 14 loci were rated. These included: aspartate aminotransferase (AAT-A, AAT-B, and AAT-C), aldolase (ALD), endopeptidase (ENP), glutamate dehydrogenase (GDH-A, GDH-B), isocitrate dehydrogenase (IDH), malate dehydrogenase (MDH-A, MDH-B, and MDH-C), 6-phosphogluconate dehydrogenase (PGD-A, PGD-B), and shikimate dehydrogenase (SAD). Aspartate aminotransferase is identical to glutamate oxaloacetate transaminase. Genetic diversity and genetic differences were calculated according to the formulas of Nei (1972).

RESULTS

The number of active electromorphs at each loci and the genetic diversity for each isozyme locus is shown in Table 1. Of the 14 loci screened, three were monomorphic for all lines tested. More polymorphic loci were observed among the Asian accessions, however, three of the loci tested had higher variability in the South American populations. Of these three loci, two had electromorphs which were unique to the South American populations. The third loci had an allele which was common in South America and was not observed in the Asian lines screened in this study, but may correspond to a rare electromorph observed by Second (1985). The distribution of the alleles for the more variable loci among the South American lines was correlated to the site of collection, suggesting that there may be selection acting on the

alleles at those loci. A number of the accessions were collected from "black water" areas where Ph and nutrient level is quite low and considerable sterility was seen in the wild in plants collected in these areas, suggesting a severe selection pressure was present.

The overall variability seen among the South American accessions was somewhat lower than that of the Asian and Australian lines (Table 2). Fewer polymorphic loci were also observed. This could be due to a founder effect. Since the South American lines are common in areas with no history of rice cultivation, it is not likely that they would have been weedy escapes and the accidental introduction of a wild Oryza species from Asia would have been a rare event. Most of the genetic variability would have arisen through mutation since introduction to the area. A second possibility is that the variability is less because a smaller area of the total range of the South American species was sampled in comparison to the Asian lines. In either case, the presence of unique alleles indicates the value of the South American accessions as germplasm sources. When these lines are cleared through quarantine they will be tested for resistance to rice water weevils and also as possible sources of genes for increased efficiency of fertilizer use.

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Table 1. Number of active electromorphs and genic diversity at 14 loci among three sativae series rice taxa.

	Number active electromorphs	Genic diversity : H^+		
		G	M	A
AATA	4	.15	0	.04
AATB	2	.02	.16	.04
AATC	3	0	.44	.21
ALD	4	.64	0	.28
ENP	3	0	0	.43
GDHA	3	0	0	.08
GDHB	1	0	0	0
IDH	5	.15	0	.29
MDHA	1	0	0	0
MDHB	2	0	.38	0
MDHC	1	0	0	0
PGDA	3	.03	.5	.31
PGDB	2	.03	.38	.15
SAD	4	.58	.38	.45

\$ H = 1 minus the sum of squares of the frequencies of each electromorph

G = O. glumaepatula

M = O. meridionalis

A = O. nivara, O. "perennis", and O. rufipogon combined

Table 2. Estimates of I and D among three sativae series taxa.⁺

	G	M	A*
G	(.8857)	.4620	.2231
M	.63	(.8400)	.3425
A	.80	.71	(.8371)

⁺ Where I = covariance of the frequencies of electromorphs, $D = \log_e I$ values on the diagonal are the average homozygosities.

* G = O. glumaepatula, M = O. meridionalis, A = the Asian A genome diploids combined: O. nivara, O. "perennis", and O. rufipogon.

GENETIC BASIS OF SELECTED SOMACLONAL VARIANTS IN THE RICE CULTIVAR 'LEMONT'

E.M. Nowick, Cao Jun, and M.C. Rush

INTRODUCTION

The appearance of variation in plants regenerated from tissue culture has been well documented in rice, as well as in other crops (Sun, et. al., 1983; Oono, 1985). It has been suggested that this variability may provide a novel source of beneficial genes for plant breeding. However, the usefulness of this variability for genetic improvement of rice will depend on the stability of the new traits and on their heritability. The research reported here was undertaken to determine the inheritance of several somaclonal variants produced in the cultivar 'Lemont.'

MATERIALS AND METHODS

The sources and culture methods for the somaclonally produced plants and their range of variation is reported elsewhere (Jun, 1986). Three of the variants studied appeared to segregate in the M_2 generation. Of these three, two appeared to segregate for dwarf plants. The remaining variant had putative segregates with brown leaf tips. Two other variants studied appeared to be uniformly taller than Lemont in the M_2 . Crosses were made between the somaclonal variants and Lemont. Chromosomes were stained in F_1 meiotic pollen mother cells to determine if the variation could be due to cytological abnormalities. The F_2 plants were grown in the field in 1986 and segregation ratios determined for each F_2 populations. For the tall variants, the F_2 populations were again tested in 1987. For those traits showing apparent Mendelian segregation, Chi-square tests for goodness of fit were made. For the apparently uniform traits, Chi-square tests for homogeneity of distribution were made among the parents and progeny (Snedecor and Cochran, 1967). Classes were combined to give an expected value of at least one.

RESULTS AND DISCUSSION

The only chromosomal abnormalities observed were occasional anaphase bridges and these were seen in both variant and control plants. For the variants used in this study, it was apparent that gross chromosomal changes were not the cause of the observed changes in phenotype.

For those variants that appeared to be segregating in the M_2 , ratios for the variant and normal plants in the F_2 were not significantly different for those expected from a single recessive mutation (Table 1). However, no apparent Mendelian segregation was observed for the uniformly taller lines in F_2 's of crosses to the normal Lemont. Heritability estimated from the F_2 and parental variances from the crosses involving the uniformly tall variants was low, but plants exceeding the height of Lemont were observed in both years of testing (Table 2). There was some evidence of instability in one selfed progeny line of the tall variant 267 and very tall plants were observed in this line.

Table 1. Segregation ratios and Chi-square tests of F_2 population from crosses between Lemont and segregating variants.

Cross	F_2 plants	χ^2 (1:3)	
Lemont/304	29 brown leaf tip:110 normal	$\chi^2 = 1.27$	.25<P<.5
Lemont/656	12 dwarf : 51 normal	$\chi^2 = .5$	.25<P<.5
Lemont/417	28 dwarf :105 normal	$\chi^2 = 1.11$	.25<P<.5

Table 2. Means and standard deviations of plant height in mm for F_2 populations of Lemont by uniformly tall somaclonal variant crosses.

F_2	1986				1987			
	n	$\bar{x}$ (mm)	range	sd	n	$\bar{x}$	range	sd
Lemont	124	696	606-810	49.14	119	684	600-760	28.40
Lemont/267	145	714	600-840	42.48	78	706	600-830	44.76
267/Lemont					38	695	620-750	28.40
267,selfed (3948)	8	789	590-820	35.90	125	723	590-820	38.25
267,selfed (3939)					240	718	570-1060	88.08
Lemont	124	696	606-810	49.14	119	684	600-760	28.40
Lemont/113	134	685	600-855	43.58	128	697	600-830	42.70
113/Lemont					38	678	610-740	28.99
113, selfed	2	752			124	712	630-830	37.60

Although the genetic nature of the somaclonal variations studied could not be determined from this study, it appeared that this variation could be transferred in crosses and the inheritance was not different from variation produced through conventional means. The Mendelian traits could have been due to point mutations, small insertions, or deletions. The inheritance of the tall variants was similar to what would have been expected for a mutation in a gene with a minor effect on the trait in question. The only evidence for a novel source of variation was the instability observed in the selfed progeny of 267. Although the traits studied were not of major importance in breeding, the results of this study indicate that somaclonal variation could be used in a breeding program with methods similar to those used for other source of variability.

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RICE TISSUE CULTURE RESEARCH

TISSUE CULTURE PRODUCTION OF COMMERCIAL RICE VARIETIES RESISTANT TO HERBICIDES EFFECTIVE ON RED RICE^{1/}

T.P. Croughan, J.B. Baker, R.T. Dunand, and M.M. Meche

Red rice is one of the more important weed pests in rice. The genetic similarity to cultivated rice has made red rice difficult to control chemically, as nearly all herbicides effective on red rice are equally toxic to cultivated rice. A possible solution would be the development of cultivated rice genetically resistant to herbicides effective on red rice. Activities in this project have concentrated on developing herbicide resistant rice, using the herbicides Dual (metolachlor) and Roundup (glyphosate). Four basic approaches were utilized: 1) screening germplasm for existing inherent resistance; 2) attempting to develop mutants with resistance through mutation breeding using gamma radiation; 3) screening for herbicide resistance at the cellular level; and 4) testing for somaclonal variation for herbicide resistance among nonselected regenerated lines. A total of 647 germplasm lines were screened for inherent resistance, including 107 domestic and foreign cultivars and 540 breeding lines. Testing progeny from gamma irradiated material involved screening a total of 60 million M_2 seed for resistance to Dual and 180 million M_2 seed for resistance to Roundup. Screening for herbicide resistance involved plating cells on a range of Dual concentrations in the nutrient medium. A total of 592 somaclones were developed and tested for resistance to Dual. The various approaches produced 152 lines with distinguishable improvements in resistance, but none of those lines were sufficiently improved to be agronomically useful. Anticipated future activities in this area include the screening of progeny from an additional 8,000 somaclones produced this year.

^{1/} This research supported in part by funds provided by rice producers through the Louisiana Rice Research Board.

IMPROVEMENT OF WHEAT AND FORAGE CROPS THROUGH TISSUE CULTURE

T.P. Croughan, J.L. Griffin, and M.M. Meche

Activities in this project during 1987 have included: 1) field evaluation of disease resistance among R_3 wheat lines; 2) production of approximately 6,000 new regenerated wheat lines; 3) planting of 200 field plots to evaluate yield of regenerated lines; and 4) planting of 2,000 individual rows of R_2 wheat lines for preliminary disease screening and production of additional seed for further testing.

Several regenerated lines have shown improved resistance to leaf rust for two years, having been field tested in one location the first year and two locations the second. These lines are currently being yield tested in replicated 7-row plots 12 m in length. Additional lines are being evaluated in preliminary yield plots 3 m in length. The 6,000 new regenerated lines were transplanted to the field, spaced 1.2 m apart, and occupy a total area of approximately 1 ha. At maturity, seed harvested from these plants will be used to plant progeny rows to evaluate for improvements in agronomic characters and disease resistance.

CELLULAR AND MOLECULAR GENETICS FOR CROP IMPROVEMENT

T.P. Croughan, Q.R. Chu, E.M. Nowick, K.S. McKenzie, and M.M. Meche

Activities in this project have included: 1) field evaluations of progeny from rice somaclones produced through tissue culture; 2) a study on the effects on rice anther culture of the nitrogen nutritional status of the donor plant; and 3) studies on the genetics of callus formation and plant regeneration in rice.

Rice somaclones were produced from immature panicle and root derived callus. Regenerated plants were grown to maturity in the greenhouse to provide seed for field testing. A broad range of genetic alterations was found among more than 8,000 somaclones evaluated in the field, including changes in plant height, days to maturity, panicle size, seedling vigor, seed weight, seed size, tiller number, lodging resistance, yield, hull color, and stem elongation pattern. A somaclone regenerated from root derived callus of the rice variety 'Saturn' had eight distinguishable differences from the original variety, including changes in panicle size, seed size, tiller number, days to maturity, mature plant height, seedling vigor, and stem elongation pattern. A study on the effects of nitrogen status of the donor plant on subsequent anther culture performance showed that intermediate fertility levels were superior to both low and high nitrogen levels. Other activities in the project included an evaluation of the anther culturability of 10 indica rice varieties, and a subsequent diallel cross between three of these with the U.S. variety 'Lemont.' Parents for the diallel were chosen to have complementary traits with respect to callus formation and plant regeneration rates. An additional 8,000 somaclones have been developed and are currently growing in the greenhouse to provide seed for progeny rows, and 400 somaclonal lines selected in 1987 will be yield tested in replicated field plots in 1988.

THE USE OF ANTHER CULTURE TO EXPEDITE THE BREEDING
AND RELEASE OF NEW VARIETIES OF RICE

T.P. Croughan, Q.R. Chu, K.S. McKenzie, H.J. Huang, and M.M. Meche

Several years of the time required to develop new rice varieties is typically spent obtaining homozygous lines following the initial hybridization step. Anther culture offers an alternative in which homozygous lines are developed in the laboratory in less than a year. Activities in this project included: 1) an evaluation of the suitability for anther culture of southern U.S. rice germplasm; 2) testing various media and procedures to improve callus formation and plant regeneration rates; 3) evaluating gametoclonal variability; and 4) using anther culture of F_1 , F_2 , BCF_1 , and BCF_2 lines to produce homozygous lines from breeding program material.

All of the major varieties of rice grown in the southern U.S. proved suitable for anther culture, though there were clear genetic differences in rates of callus formation and plant regeneration. Media containing high levels of auxin, such as 2 mg/l 2,4-D, proved best for inducing callus formation from anthers, and media containing kinetin and elevated sucrose levels were best for regeneration. Anther culture of homozygous cultivars produced genetic variability, including reductions in plant height. The best pollen maturity stage for anther culture corresponded to a spacing of 3 to 5 cm between the flag and penultimate leaf collars. Pretreatment of anthers at 12°C for 25 days maximized callus formation, but 7 days at 6°C produced the highest number of regenerated plants. A total of over 5,000 lines have been developed through anther culture of hybrid and backcrossed material, and are currently being evaluated.

THE RELATIONSHIP BETWEEN HARVEST MOISTURE AND MILLING YIELD FOR COMMERCIAL AND EXPERIMENTAL RICE LINES

M.F. Miller, K.S. McKenzie, and F. Jodari

INTRODUCTION

The objectives of this project are as follows:

1. To determine what effect harvest moisture has on milling yield.
2. To determine what effect drying, rewetting, and redrying of rice in the field has on milling yield.
3. To determine the optimum harvest moisture and the milling characteristics of commercial and experimental rice lines.

MATERIALS AND METHODS

This project is conducted in cooperation with the plant breeding program at the Rice Research Station. Two varieties were sampled in 1987. They were 2201, a long-grain experimental line, and Mercury, which has a medium size kernel. It was released by this station in 1987. Harvesting was done by hand over an extended period of time, starting when the grain moisture was near 25% and continued until it was down to about 12%. During this time span, there was drying, wetting, due to rain and dew, and redrying of the grain while still in the field. After harvesting, the samples were threshed, cleaned, and the moisture taken. They were then dried to approximately 12% and sealed in pint glass jars until they were milled. The milling was done using standard laboratory milling equipment. Yield data was obtained through the use of USDA type machines, procedures, and standards.

RESULTS AND DISCUSSION

Milling yield and analysis of variance for 2201 and Mercury are shown in Figures 1 and 2 and Tables 1 and 2.

The mean percent of brown rice for 2201 was 82.1 and ranged from a low of 81.1 to a high of 83.0. The percent brown rice versus harvest moisture showed a linear relationship. The total milled rice yield ranged from a high of 70.0% to a low of 66.7% and averaged 68.5%. There was a slight decrease in total milled rice as harvest moisture decreased. Head rice yield ranged from 42.0% to 55.8% with a mean of 53.8%. Since it appeared to be linear, more information at higher moisture levels is needed. The coefficient of determination for the percent head rice and harvest moisture was 0.89**.

The mean percent of brown rice for Mercury was 81.3 and ranged from 80.4 to 88.2. Yield of total milled rice ranged from 69.0% to 66.1% and had a mean of 67.8%. The percent of head rice varied from 15.3 to 62.4. The coefficient of determination for the percent head rice versus harvest moisture was 0.96**. Additional data at higher harvest moisture is needed and will be collected in 1988.

Table 1. Mean square of harvest moisture, percent brown rice, percent total milled rice, and percent head rice for 2201. Rice Research Station, Crowley, LA. 1987.

Source of variation	df	Harvest moisture	Percent brown rice	Percent total milled rice	Percent head rice
Rep	3	0.14	0.20	0.81	18.70
Harvest	6	22.49**	0.74**	2.01**	91.95**
Error	18	0.27	0.05	0.30	4.11
CV		3.11	0.29	0.80	3.79

** Significant at 0.01 probability level.

Table 2. Mean square of harvest moisture, percent brown rice, percent total milled rice, and percent head rice for Mercury. Rice Research Station, Crowley, LA. 1987.

Source of variation	df	Harvest moisture	Percent brown rice	Percent total milled rice	Percent head rice
Rep	3	4.78**	1.67	0.64*	19.83
Harvest	9	53.01**	1.26	2.15**	794.94**
Error	27	0.24	1.31	0.19	10.00
CV		2.57	1.41	0.65	7.10

* Significant at 0.05 probability level.

** Significant at 0.01 probability level.

RICE FERTILIZATION AND CULTURAL MANAGEMENT

EFFECT OF N RATE AND TIMING ON PERFORMANCE AND YIELD OF SELECTED RICE VARIETIES AND ADVANCED EXPERIMENTAL LINES IN LOUISIANA RICE PRODUCING AREAS

P.K. Bollich, W.J. Leonards, Jr., S.M. Rawls, and D.M. Walker

INTRODUCTION

Fertilizer nitrogen (N) is required on virtually all of the rice acreage in Louisiana for optimum production. Efficiency and uptake of applied N is influenced by factors such as placement, rate, and timing in relation to water management. Growing a suitable rice variety coupled with management practices that conserve applied N generally increase the chance of profitable rice production.

The placement and timing of fertilizer N is dependent upon the cultural system used. In Louisiana, rice is grown in water- and dry-seeded cultural systems. In the water-seeded, permanently flooded system, the optimum N rate should be placed 2 to 3 inches below the soil surface within 5 to 7 days of establishing the flood. In the dry-seeded system, the optimum N rate should be broadcast onto a dry soil surface prior to establishing the permanent flood. There is generally no advantage in applying multiple applications of fertilizer N in either cultural system provided there is precision in N placement and sound water management. Split applications may be desirable if the optimum N rate is not known, if the farmer is unfamiliar with a field, or if a variety is susceptible to lodging. When applying split applications, it is important to apply an adequate amount of basal N to maintain the rice plant through the tillering stage and into early reproductive growth. Generally, a split application consists of two-thirds of the estimated total N requirement applied preplant in water-seeded rice and preflood in dry-seeded rice, followed by a topdressing of the remaining one-third at either panicle initiation, panicle differentiation, or when deficiency symptoms appear.

Rice varieties may differ in their response to the amount and timing of applied N. Maximum or optimum yield of many varieties may occur over a wide range of N rates, depending on such factors as lodging, disease susceptibility, and inherent N utilization efficiency. Environmental influences such as soil type, growing conditions, pest pressure, and weather may affect varietal performance. Conducting field research in the major rice producing areas of Louisiana provides valuable information for developing fertilization and management strategies for new varieties.

The objectives of these variety x N trials are to 1) determine yield potential and agronomic performance of new rice varieties and advanced experimental lines in different environments, and 2) determine the optimum N rate and time of N application for each variety.

MATERIALS AND METHODS

Ten rice varieties and/or advanced experimental lines were grouped by maturity and grain type into four groups for testing:

1. Early medium grain: Mars (MARS), Mercury (MERC)
2. Very early long grain: Tebonnet (TBNT), Skybonnet (SKBT)
3. Early long grain: Lemont (LMNT), Gulfmont (GFMT), 2201, 2203
4. Midseason specialty long grain: Della (DLA), 2186

Mars is a tall, early season medium-grain variety with good yield potential developed in Arkansas. It is susceptible to lodging, especially at high rates of N fertilization. Mercury (formerly advanced experimental line 2213), is a semidwarf medium grain released from the breeding program in Louisiana in 1987. Straw strength of MERC is similar to that of MARS but is more resistant to lodging at high N rates, due mainly to its shorter height. Yield potential of MARS and MERC appear to be similar, with each displaying good second crop potential.

Tebonnet is a tall variety developed in Arkansas. It has displayed high yield potential and is susceptible to lodging. Skybonnet, a Texas variety, is the latest maturing of the two and has displayed somewhat less yield potential, than TBNT in previous tests. Skybonnet is shorter than TBNT, has better lodging resistance, and has excellent second crop yield potential.

The early long-grain group includes the Texas varieties LMNT and GFMT. Lemont has consistently shown excellent yield potential, is resistant to lodging, and responds well to high levels of fertilizer N. Gulfmont is very similar to LMNT in growth habit, and is 2 to 3 days earlier. It has yield potential similar to LMNT, and both have produced excellent second crop yields in previous tests. The two advanced experimental lines 2201 and 2203, were developed in the Louisiana breeding program. Both lines are semidwarfs with good lodging resistance and have displayed good yield potential in the first and second crops. Height and maturity are similar to that of LMNT and GFMT.

Della is a tall, aromatic long grain with lower yield potential and is very susceptible to lodging. Experimental line 2186 was developed in the Louisiana breeding program, is shorter than DLA, has similar yield potential and better lodging resistance.

Nitrogen rates of 0, 30, 60, 90, 120, and 150 lb/A were banded approximately 2 inches deep 1 to 2 days prior to flooding in the water-seeded experiments. In soils requiring P and K, approximately 60 lb/A P_2O_5 and K_2O were also banded with N as ammonium sulfate. The 90 lb N/A rate was also split to provide 60 lb N/A preplant with 30 lb N/A applied at either panicle initiation (green ring) or panicle differentiation (panicle 2 mm) growth stages. In drill-seeded experiments, basal N treatments were applied as a broadcast application prior to establishment of the permanent flood with split applications of the 90 lb N/A rate applied as in the water-seeded experiments.

Water-seeded experiments were seeded at the rate of 150 lb/A with presoaked seed. After 3 to 4 days, the experiments were drained briefly to promote seedling anchorage. A permanent flood was established 2 to 4 days

after drainage, never allowing the soil to dry. In drill-seeded experiments, varieties were seeded at 100 lb/A and flushed periodically until the permanent flood was established (4 to 5 weeks after planting).

Pest control (weeds, insects, disease), when necessary, was practiced according to current recommendations. Individual whole plots were combine-harvested at field maturity. Days to 50% heading, plant height, lodging, grain moisture, and grain yield were measured.

Second crop data were generated in the Vermilion Parish and Rice Research Station (RRS) variety x N trials. After main crop harvest, the stubble was clipped to a uniform height (8 to 12 inches, depending on trial). Either 45 or 60 lb N/A was broadcast into the dry stubble, and a shallow flood was established immediately. Individual whole plots were combine-harvested at field maturity. Grain moisture and grain yield were determined.

SUMMARY AND CONCLUSIONS

Field experiments were conducted at the RRS and in East Carroll and Vermilion parishes to determine N response of new rice varieties and experimental lines when grown in different environments.

The N requirement for most water-seeded varieties and experimental lines at the RRS and in Vermilion was similar. Approximately 90 lb N/A was required for optimum grain yields of MARS, MERC, TBNT, SKBT, LMNT, GFMT, 2201, 2203, DLLA, and 2186 at the RRS, and MERC, SKBT, LMNT, GFMT, 2201, and 2203 in Vermilion. Mars and TBNT produced optimum grain yields at a N rate of 60 lb/A. Della and 2186 both lodged severely at all N rates in Vermilion. Experimental line 2201 and MERC produced the highest grain yields of tests conducted at the RRS and in Vermilion.

Early cold temperatures during reproductive growth of the second crop limited yield potential of all varieties, especially those in the early long-grain experiments. Yield data was determined for the medium and very early long-grain experiments. Second crop grain yields of MARS decreased somewhat at high rates of N fertilization in the main crop at the RRS. Grain yields of MERC at each southwest Louisiana location and grain yields of MARS in Vermilion were stable across N fertilization rates. Second crop grain yields of SKBT were much higher than TBNT at each location.

The N requirement for most drill-seeded varieties and experimental lines in East Carroll was higher for optimum grain yields than in southwest Louisiana. Mars, SKBT, 2201, and 2203 required 120 lb N/A for optimum grain yields. The varieties LMNT and GFMT responded to a higher N rate of 150 lb/A. Tebonnet and MERC produced optimum yields at a N rate of 90 lb/A. Performance of MERC was rather poor, yielding significantly less than MARS. Tebonnet also outyielded SKBT, and required less N for optimum grain yield. Lemont produced the highest grain yield in the early long-grain experiment. Performance of GFMT and 2201 was similar.

Experiment: Early medium grain x nitrogen trial

Location: Rice Research Station

Soil Type/Analysis: Crowley silt loam; ph: 6.1; O.M.: 0.77%; extractable nutrients (mg/kg): P-36, Na-46, K-53, Ca-940, Mg-169, Zn-0.74

Variety/Seeding Rate: MARS, MERC, 150 lb/A

Planting Method/Date: Water-seeded, Apr 9

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; nitrogen source, ammonium sulfate; second crop, 60 lb N/A

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: MERC, Apr 15; MARS, Apr 16

Water Management: Initial flood, Apr 8; drained, Apr 14; reflooded, Apr 16; drained, Apr 25; reflooded, Apr 28; drained, May 10; permanent flood, May 12; harvest drainage, July 23; second crop flooded, Aug 14; harvest drainage, Oct 18

Herbicides: 4 lb ai/A, Stam (propanil), Apr 27; 3 lb ai/A Stam + 0.75 lb ai/A Basagran (bentazon), May 11

Insecticides: 0.6 lb ai/A, Furadan (carbofuran), May 27

Fungicides: None

Harvest: Main crop, Aug 13; second crop, Nov 2

Experimental Design: Split plot in a randomized complete block with four replications, nitrogen treatments assigned to main plots and varieties to subplots

Comments: MARS and MERC both displayed good seedling vigor and fast emergence under very cool weather conditions. A N response was noted 3 weeks after emergence. Slight to moderate N deficiency symptoms occurred 5 weeks after emergence at N rates of 30 lb/A. Days to 50% was influenced only slightly (Table 1). MERC displayed excellent lodging resistance, especially at high N rates. Lodging susceptibility of the taller MARS variety increased at N rates of 90 lb/A and greater. Optimum grain yield of MARS occurred at a N rate of 90 lb/A, while MERC required 120 lb N/A. Grain yield of MERC was significantly higher than that of MARS.

Both varieties produced good regrowth and second crop grain yields. High main crop N rates for MARS decreased second crop yields, probably due to increased lodging and stand reduction of the main crop. Grain yields of MERC were constant across main crop N rates.

Table 1. Effect of N rate and timing in main crop on performance and on main crop, second crop, and total grain yields of water-seeded early medium-grain rice varieties. Rice Research Station, Crowley, LA. 1987.

Time of N*				Days to 50% heading				Plant height				% Lodging /type**				Main crop grain yield at 12% moisture				Second crop grain yield at 12% moisture				Total grain yield at 12% moisture							
N***				N***				N***				N***				N***				N***				N***							
MARS				MERC				MARS				MERC				MARS				MERC				MARS				MERC			
PD				PI				PP				PI				PD				PP				PI				PD			
lb/A				lb/A				lb/A				lb/A				lb/A				lb/A				lb/A							
0	--	--	--	85	82	84 ^c	79	69	74 ^d	0/0	0/0	0/0	4400	4414	4407 ^e	2462	1961	2212 ^{ab}	6862	6376	6619 ^e										
30	30	--	--	84	81	82 ^d	91	79	85 ^c	0/0	0/0	0/0	6124	6683	6403 ^d	2502	2176	2339 ^a	8626	8859	8742 ^d										
60	60	--	--	84	81	82 ^d	100	82	91 ^b	0/0	0/0	0/0	7446	7338	7392 ^c	1949	2156	2052 ^{bc}	9395	9494	9444 ^{bc}										
90	90	--	--	85	82	84 ^c	106	85	96 ^a	10/1	0/0	0/0	7929	8032	7981 ^a	1741	2069	1905 ^{cd}	9670	10101	9886 ^{ab}										
90	60	30	--	85	82	84 ^c	107	86	97 ^a	42/4	2/1	2/1	7739	8546	8142 ^a	1838	1534	1686 ^{de}	9577	10080	9828 ^{ab}										
90	60	--	30	84	82	83 ^c	107	86	97 ^a	37/3	0/0	0/0	7858	8457	8158 ^{ab}	1671	1918	1794 ^{de}	9529	10375	9952 ^a										
120	120	--	--	86	83	85 ^b	109	86	98 ^a	72/3	0/0	0/0	7149	8750	7949 ^{ab}	1536	2005	1770 ^{de}	8684	10755	9720 ^{ab}										
150	150	--	--	87	84	86 ^a	108	90	99 ^a	87/4	2/1	2/1	6493	8671	7582 ^{bc}	1156	1987	1572 ^e	7649	10659	9154 ^{cd}										
Variety mean***				85 ^a	82 ^b		101 ^a	83 ^b					6892 ^b	7612 ^a		1857 ^b	1976 ^a		8749 ^b	9587 ^a											
C.V., %					0.53			2.77						5.34			10.43			4.76											

* Time of N: PP = preplant; PI = panicle initiation; PD = panicle differentiation.

** Lodging rate in percent/lodging type on a scale of 0 to 5, where 1 = leaning and 5 = complete.

*** Means across and down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Very early long grain x nitrogen trial

Location: Rice Research Station

Soil Type/Analysis: Crowley silt loam; ph: 6.1; O.M.: 0.77%; extractable nutrients (mg/kg): P-36, Na-46, K-53, Ca-940, Mg-169, Zn-0.74

Variety/Seeding Rate: TBNT, SKBT, 150 lb/A

Planting Method/Date: Water-seeded, Apr 9

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; nitrogen source, ammonium sulfate; second crop, 60 lb N/A

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: TBNT, Apr 16; SKBT, Apr 18

Water Management: Initial flood, Apr 9; drained, Apr 14; reflooded, Apr 16; drained, Apr 25; reflooded, Apr 28; drained, May 10; permanent flood, May 12; harvest drainage, July 21; second crop flooded, Aug 14; harvest drainage, Oct 30

Herbicides: 4 lb ai/A, Stam (propanil), Apr 27; 3 lb ai/A Stam + 0.75 Basagran (bentazon), May 11

Insecticides: 0.6 lb ai/A, Furadan (carbofuran), May 27

Fungicides: None

Harvest: Main crop, Aug 5; second crop, Nov 6

Experimental Design: Split plot in a randomized complete block with four replications, nitrogen treatments assigned to main plots and varieties to subplots

Comments: TBNT and SKBT displayed poor seedling vigor during emergence and establishment. Moderate N deficiency was observed at the 0 and 30 lb N/A rates 5 weeks after emergence. Days to 50% heading was increased with increasing N for each variety (Table 2). SKBT displayed good lodging resistance at high rates of N. TBNT lodged severely at N rates above 90 lb/A. Optimum N rate for TBNT was 90 lb/A, applied as a split application. Optimum grain yield for SKBT resulted from a single application of 90 lb N/A. TBNT grain yield was slightly higher than that of SKBT.

Regrowth and grain yields of the SKBT second crop were much higher than those of TBNT. High main crop N rates significantly decreased TBNT grain yields, especially when main crop lodging occurred. Second crop grain yields of SKBT were more stable at high rates of main crop N fertilization, although some decrease was observed.

Table 2. Effect of N rate and timing in main crop on performance and on main crop, second crop, and total yields of water-seeded very early long-grain rice varieties. Rice Research Station, Crowley, LA. 1987.

Time of N*				Days to 50% heading				Plant height				% Lodging /type**				Main crop grain yield at 12% moisture				Second crop grain yield at 12% moisture				Total grain yield at 12% moisture			
Total				N***				N***				N***				N***				N***				N***			
N	PP	PI	PD	TBNT	SKBT	Mean	TBNT	SKBT	Mean	TBNT	SKBT	Mean	TBNT	SKBT	Mean	TBNT	SKBT	Mean	TBNT	SKBT	Mean	TBNT	SKBT	Mean			
-----lb/A-----																											
0	--	--	--	71	77	74 ^d	91	85	88 ^f	0/0	0/0	0/0	4427	5140	4783 ^e	2048	2441	2244 ^a	6475	7581	7028 ^c						
30	30	--	--	74	78	76 ^c	104	96	100 ^e	0/0	0/0	0/0	6556	6564	6560 ^d	1626	2413	2019 ^{ab}	8182	8977	8579 ^b						
60	60	--	--	77	79	78 ^c	114	106	110 ^d	0/0	0/0	0/0	8012	7378	7695 ^b	1696	2082	1889 ^b	9708	9459	9583 ^a						
90	90	--	--	80	82	81 ^b	122	111	116 ^c	5/1	0/0	0/0	8269	7895	8082 ^{ab}	1491	2018	1754 ^{bc}	9760	9913	9836 ^a						
90	60	30	--	81	83	82 ^b	126	112	119 ^{bc}	0/0	0/0	0/0	8562	7617	8090 ^{ab}	1154	1880	1517 ^{cd}	9716	9497	9607 ^a						
90	60	--	30	80	82	81 ^b	123	113	118 ^{bc}	5/1	2/1	2/1	8615	7688	8151 ^a	1085	1727	1406 ^d	9700	9415	9558 ^a						
120	120	--	--	82	84	83 ^{ab}	126	114	120 ^{ab}	40/4	0/0	0/0	7866	7568	7717 ^{ab}	774	1668	1221 ^d	8640	9235	8938 ^b						
150	150	--	--	83	85	84 ^a	126	119	123 ^a	67/3	0/0	0/0	7184	7358	7271 ^c	662	1765	1214 ^d	7846	9123	8484 ^b						
Variety mean***				78 ^b	81 ^a		117 ^a	107 ^b		7436 ^a	7151 ^b		1317 ^b	1999 ^a					8753 ^b	9150 ^a							
C.V., %					1.52			2.65					5.67					16.97			5.47						

* Time of N: PP = preplant; PI = panicle initiation; PD = panicle differentiation.

** Lodging rate in percent/lodging type on a scale of 0 to 5, where 1 = leaning and 5 = complete.

*** Means across and down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Early long grain x nitrogen trial

Location: Rice Research Station

Soil Type/Analysis: Crowley silt loam; ph: 6.1; O.M.: 0.77%; extractable nutrients (mg/kg): P-36, Na-46, K-53, Ca-940, Mg-169, Zn-0.74

Variety/Seeding Rate: LMNT, GFMT, 2201, 2203, 150 lb/A

Planting Method/Date: Water-seeded, Apr 10

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; nitrogen source, ammonium sulfate; second crop, 60 lb N/A

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: GFMT, 2203, Apr 17; LMNT, 2201, Apr 8

Water Management: Initial flood, Apr 9; drained, Apr 14; reflooded, Apr 16; drained, Apr 25; reflooded, Apr 28; drained, May 10; permanent flood, May 12; harvest drainage, July 24; second crop flooded, Aug 14; harvest drainage, Oct 18

Herbicides: 4 lb ai/A, Stam (propanil), Apr 27; 3 lb ai/A Stam + 0.75 Basagran (bentazon), May 11

Insecticides: 0.6 lb ai/A, Furadan (carbofuran), May 27

Fungicides: None

Harvest: Aug 6

Experimental Design: Split plot in a randomized complete block with four replications, nitrogen treatments assigned to main plots and varieties to subplots

Comments: Fair seedling vigor was displayed by all varieties and lines.

Response to applied N was observed 3 weeks after emergence at rates less than 60 lb/A. Increasing rate of N increased days to 50% heading an average of 7 days (Table 3). Optimum grain yields for all varieties resulted from a N application of 90 lb/A with a positive response to a split applied at PD. Experimental line 2201 significantly outyielded the other varieties.

Good regrowth was observed for all varieties. Cold temperatures during reproductive growth limited second crop grain formation. No grain yield information was collected.

Table 3. Effect of N rate and timing on performance of water-seeded early long-grain rice varieties. Rice Research Station, Crowley, LA. 1967.

Total		Time of N*				Days to 50% heading				Plant height				Grain yield at 12% moisture				N** Mean		
		PP	PI	PD		LMNT	GFMT	2201	2203	Mean	LMNT	GFMT	2201	2203	Mean	LMNT	GFMT			2201
		lb/A								cm				lb/A						
0	--	--	--	--		83	79	81	78	80 ^e	63	64	63	62	63 ^e	5294	5340	4739	4416	4948 ^d
30	30	--	--	--		82	80	81	78	80 ^e	69	73	74	68	71 ^d	6909	7358	7574	6212	7013 ^c
60	60	--	--	--		84	81	82	80	82 ^d	76	80	73	75	76 ^c	7963	7822	8134	7683	7900 ^b
90	90	--	--	--		86	83	84	81	84 ^c	79	78	80	75	78 ^c	8136	7886	8438	8229	8172 ^{ab}
90	60	30	30	--		88	84	84	82	85 ^{bc}	80	81	81	79	81 ^b	7981	7886	8524	8300	8173 ^{ab}
90	60	--	--	30		87	84	84	82	84 ^{bc}	79	82	80	82	81 ^b	8115	8200	8814	8481	8403 ^a
120	120	--	--	--		88	85	85	82	85 ^b	81	83	83	79	82 ^{ab}	7498	7492	8565	8412	7992 ^{ab}
150	150	--	--	--		89	88	87	85	87 ^a	84	85	82	83	84 ^a	7462	7337	8281	7799	7720 ^b
Variety mean**						88 ^a	83 ^b	83 ^b	81 ^c		77 ^{bc}	78 ^a	77 ^{ab}	75 ^c		7420 ^b	7415 ^b	7884 ^a	7442 ^b	
C.V., %								0.98					3.40					5.44		

* Time of N: PP = preplant; PI = panicle initiation; PD = panicle differentiation.

** Means across and down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Midseason specialty long grain x nitrogen trial

Location: Rice Research Station

Soil Type/Analysis: Crowley silt loam; ph: 6.1; O.M.: 0.77%; extractable nutrients (mg/kg): P-36, Na-46, K-53, Ca-940, Mg-169, Zn-0.74

Variety/Seeding Rate: DLLA, 2186, 150 lb/A

Planting Method/Date: Water-seeded, Apr 03

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; nitrogen source, ammonium sulfate; second crop, 60 lb N/A

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: DLLA, 2186, Apr 13

Water Management: Initial flood, Apr 3; drained, Apr 11; reflooded, Apr 13; drained, Apr 25; reflooded, Apr 28; drained, May 10; permanent flood, May 12; harvest drainage, July 29

Herbicides: 4 lb ai/A, Stam (propanil), Apr 27; 3 lb ai/A Stam + 0.75 Basagran (bentazon), May 11

Insecticides: 0.6 lb ai/A, Furadan (carbofuran), May 27

Fungicides: None

Harvest: Aug 5

Experimental Design: Split plot in a randomized complete block with four replications, nitrogen treatments assigned to main plots and varieties to subplots

Comments: DLLA and 2186 were slow to emerge and displayed poor seedling vigor, and were probably influenced by very cool temperatures at seeding and emergence. A visual response to N was observed 3 weeks after emergence. Moderate to severe symptoms were observed 4 to 5 weeks after emergence, especially at low N levels. Days to 50% heading was increased when no N was applied (Table 4). Lodging of DLLA was severe at N rates of 120 lb/A or greater. Experimental line 2186 displayed better lodging resistance than DLLA when N was applied at rates higher than 60 lb/A. A single, preplant N application of 90 lb/A was required for optimum yield by 2186. DLLA also required a total of 90 lb N/A for optimum yield, although this was a response to a split application.

Late maturity of these materials and poor regrowth precluded second crop production.

Table 4. Effect of N rate and timing on performance and grain yields of water-seeded midseason speciality long-grain rice varieties. Rice Research Station, Crowley, LA. 1987.

Total N	Time of N*			Days to 50% heading			Plant height			% Lodging/ type**		Grain yield at 12% moisture		
	PP	PI	PD	DLA	2186	N*** Mean	DLA	2186	N*** Mean	DLA	2186	DLA	2186	N*** Mean
	-----lb/A-----			-----cm-----			-----lb/A-----							
0	--	--	--	95	96	96 ^a	99	75	87 ^e	0/0	0/0	4341	3148	3744 ^d
30	30	--	--	93	95	94 ^{bc}	111	83	97 ^d	0/0	0/0	5579	4600	5090 ^b
60	60	--	--	93	93	93 ^c	120	98	109 ^c	0/0	0/0	6087	5892	5989 ^a
90	90	--	--	93	93	93 ^c	127	105	116 ^b	20/2	0/0	5654	6321	5988 ^a
90	60	30	--	94	94	94 ^c	128	104	116 ^b	25/2	10/1	6118	6351	6235 ^a
90	60	--	30	93	94	93 ^{bc}	128	103	115 ^b	15/2	0/0	6319	6174	6246 ^a
120	120	--	--	95	94	94 ^{bc}	130	110	120 ^a	77/4	22/2	5109	5866	5487 ^b
150	150	--	--	95	95	95 ^{ab}	128	107	118 ^{ab}	70/4	77/4	4294	4746	4520 ^c
Variety mean***				94 ^a	94 ^a		121 ^a	98 ^b				5438 ^a	5387 ^a	
C.V., %					0.73			3.40					7.95	

* Time of N: PP = preplant; PI = panicle initiation; PD = panicle differentiation.

** Lodging rate in percent/lodging type on a scale of 0 to 5, where 1 = leaning and 5 = complete.

*** Means across and down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Early medium grain x nitrogen trial

Location: East Carroll Parish, Buford Perry Farm

Soil Type/Analysis: Sharkey Clay; ph: 6.2; O.M. 1.65%; extractable nutrients (mg/kg): P-145, Na-66, K-464, Ca-5562, Mg-1266, Zn-5.96

Variety/Seeding Rate: MARS, MERC, 100 lb/A

Planting Method/Date: Drill-seeded, Apr 29

Fertilization: Nitrogen source, ammonium sulfate

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: MARS, MERC, May 14

Water Management: Flushed, May 5, May 17, May 30; permanent flood, June 9; harvest drainage, Aug 31

Herbicides: 4 lb ai/A Stam (propanil) + 0.25 lb ai/A Brominal (bromoxynil), May 21; 4 lb ai/A Stam, June 9; 0.75 lb ai/A Basagran (bentazon), June 26

Insecticides: 0.6 lb ai/A Furadan (carbofuran), July 8

Fungicides: 0.5 lb ai/A Benlate (benomyl), Aug 13

Harvest: Sep 15

Experimental Design: Split plot in a randomized complete block with four replications, nitrogen treatments assigned to main plots and varieties to subplots

Comments: Slow emergence and moderate seedling vigor were observed for MARS and MERC. Increasing N had little influence on days to 50% heading (Table 5). MARS did not lodge until 150 lb N/A was applied. No lodging was observed in MERC. Optimum grain yields for MARS and MERC occurred at 120 and 90 lbs N/A, respectively. Grain yield of MARS was significantly higher than those of MERC.

Table 5. Effect of N rate and timing on performance and grain yields of drill-seeded early medium-grain rice varieties. Buford Perry Farm, East Carroll Parish, LA. 1987.

Total N	Time of N*			Days to 50% heading			Plant height			% Lodging/ type**			Grain yield at 12% moisture		
	PF	PI	PD	MARS	MERC	N*** Mean	MARS	MERC	N*** Mean	MARS	MERC	N*** Mean	MARS	MERC	N*** Mean
	-----lb/A-----			-----cm-----			-----lb/A-----			-----lb/A-----			-----lb/A-----		
0	--	--	--	78	76	77 ^c	87	79	83 ^e	0/0	0/0	0/0	5317	4140	4728 ^d
30	30	--	--	77	77	77 ^c	96	78	87 ^d	0/0	0/0	0/0	6675	4433	5554 ^c
60	60	--	--	77	77	77 ^c	99	81	90 ^c	0/0	0/0	0/0	7277	5320	6298 ^b
90	90	--	--	78	77	78 ^{bc}	101	90	96 ^b	0/0	0/0	0/0	7392	6081	6737 ^{ab}
90	60	30	--	79	77	78 ^{bc}	103	82	92 ^c	0/0	0/0	0/0	7408	5671	6539 ^{ab}
90	60	--	30	79	77	78 ^{bc}	96	86	91 ^c	0/0	0/0	0/0	7193	5424	6309 ^b
120	120	--	--	79	77	78 ^{ab}	108	88	98 ^{ab}	0/0	0/0	0/0	7807	6056	6931 ^a
150	150	--	--	80	78	79 ^a	109	87	98 ^a	42/4	0/0	0/0	6797	5942	6370 ^b
Variety mean***				79 ^a	77 ^b		100 ^a	84 ^b					6983 ^a	5383 ^b	
C.V., %					1.32			7.94						6.75	

* Time of N: PF = pre-flood; PI = panicle initiation; PD = panicle differentiation.

** Lodging rate in percent/lodging type on a scale of 0 to 5, where 1 = leaning and 5 = complete.

*** Means across and down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Very early long grain x nitrogen trial

Location: East Carroll Parish, Buford Perry Farm

Soil Type/Analysis: Sharkey Clay; ph: 6.2; O.M. 1.52%; extractable nutrients (mg/kg): P-115, Na-60, K-371, Ca-4945, Mg-1126, Zn-5.69

Variety/Seeding Rate: TBNT, SKBT, 100 lb/A

Planting Method/Date: Drill-seeded, Apr 29

Fertilization: Nitrogen source, ammonium sulfate

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: TBNT, May 13; SKBT, May 17

Water Management: Flushed, May 5, May 17, May 30; permanent flood, June 9; harvest drainage, Aug 24

Herbicides: 4 lb ai/A Stam (propanil) + 0.25 lb ai/A Brominal (bromoxynil), May 21; 4 lb ai/A Stam, June 9; 0.75 lb ai/A Basagran (bentazon), June 26

Insecticides: 0.6 lb ai/A Furadan (carbofuran), July 8

Fungicides: 0.5 lb ai/A Benlate (benomyl), Aug 13

Harvest: Sep 14

Experimental Design: Split plot in a randomized complete block with four replications, nitrogen treatments assigned to main plots and varieties to subplots

Comments: Emergence of TBNT and SKBT was very slow, and seedling vigor poor. Days to 50% heading increased with increasing N (Table 6). SKBT displayed excellent lodging resistance. TBNT lodged when N was applied above 90 lb/A. A N rate of 90 lb/A resulted in optimum grain yields for TBNT and SKBT, with a positive response to a split application. Grain yield of TBNT averaged 650 lb/A greater than SKBT.

Table 6. Effect of N rate and timing on performance and grain yields of drill-seeded very early long-grain rice varieties. Buford Perry Farm, East Carroll Parish, LA. 1987.

Total N	Time of N*			Days to 50% heading			Plant height			% Lodging/ type**			Grain yield at 12% moisture		
	PF	PI	PD	TBNT	SKBT	N*** Mean	TBNT	SKBT	N*** Mean	TBNT	SKBT	TBNT	SKBT	N*** Mean	
	lb/A-----			cm-----			lb/A-----			lb/A-----			lb/A-----		
0	--	--	--	75	79	77 ^d	87	86	86 ^g	0/0	0/0	4819	4621	4720 ^d	
30	30	--	--	78	80	79 ^c	93	89	91 ^f	0/0	0/0	5601	5502	5552 ^c	
60	60	--	--	78	81	80 ^c	105	95	100 ^e	0/0	0/0	7064	6005	6535 ^b	
90	90	--	--	80	82	81 ^b	112	104	108 ^c	0/0	0/0	7595	6580	7087 ^a	
90	60	30	--	78	81	80 ^c	110	98	104 ^d	0/0	0/0	7936	6634	7285 ^a	
90	60	--	30	78	80	79 ^c	105	100	102 ^{de}	0/0	0/0	7784	6884	7334 ^a	
120	120	--	--	81	83	82 ^b	120	111	115 ^b	27/2	0/0	7822	7075	7449 ^a	
150	150	--	--	83	84	84 ^a	127	112	120 ^a	52/3	0/0	7265	7140	7203 ^a	
Variety mean***				79 ^b	82 ^a		107 ^a	99 ^b				6986 ^a	6305 ^b		
C.V., %					1.17			2.69					5.11		

* Time of N: PF = pre-flood; PI = panicle initiation; PD = panicle differentiation.

** Lodging rate in percent/lodging type on a scale of 0 to 5, where 1 = leaning and 5 = complete.

*** Means across and down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Early long grain x nitrogen trial

Location: East Carroll Parish, Buford Perry Farm

Soil Type/Analysis: Sharkey Clay; ph: 6.2; O.M. 1.56%; extractable nutrients (mg/kg): P-121, Na-55, K-400, Ca-5208, Mg-1184, Zn-5.96

Variety/Seeding Rate: LMNT, GFMT, 2201, 2203, 100 lb/A

Planting Method/Date: Drill-seeded, Apr 29

Fertilization: Nitrogen source, ammonium sulfate

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: LMNT, May 14; GFMT, May 15; 2201, 2203, May 17

Water Management: Flushed, May 5, May 17, May 30; permanent flood, June 9; harvest drainage, Aug 31

Herbicides: 4 lb ai/A Stam (propanil) + 0.25 lb ai/A Brominal (bromoxynil), May 21; 4 lb ai/A Stam, June 9; 0.75 lb ai/A Basagran (bentazon), June 26

Insecticides: 0.6 lb ai/A Furadan (carbofuran), July 8

Fungicides: 0.5 lb ai/A Benlate (benomyl), Aug 13

Harvest: Sep 15

Experimental Design: Split plot in a randomized complete block with four replications, nitrogen treatments assigned to main plots and varieties to subplots

Comments: Seedling vigor was poor and emergence slow for all varieties. Days to 50% heading was increased with increasing N (Table 7). Optimum grain yields for LMNT and GFMT required 150 lb N/A, while the experimental lines 2201 and 2203 required 120 lb N/A. Grain yields of LMNT, GFMT, and 2201 were similar. Yield of 2203 was significantly lower.

Table 7. Effect of N rate and timing on performance of drill-seeded early long-grain rice varieties. Buford Perry Farm, East Carroll Parish, LA. 1987.

Total N	Time of N*				Days to 50% heading				Plant height				Grain yield at 12% moisture				N** Mean		
	PF	PI	PD	lb/A	LMNT	GFMT	2201	2203	Mean	LMNT	GFMT	2201	2203	Mean	LMNT	GFMT		2201	2203
					cm					lb/A									
0	--	--	--		81	78	79	77	79 ^{cd}	70	68	68	70	69 ^e	5785	5191	5286	4720	5245 ^e
30	30	--	--		79	77	80	78	79 ^c	70	73	68	66	70 ^e	6461	6325	5881	5232	5975 ^d
60	60	--	--		81	78	81	78	80 ^{cd}	75	76	73	74	74 ^d	7478	6941	7380	6403	7051 ^c
90	90	--	--		82	80	82	81	81 ^b	82	81	75	77	79 ^b	8154	7535	7437	6829	7489 ^{bc}
90	60	30	--		82	79	81	79	80 ^{bc}	77	80	77	73	77 ^{bc}	7965	7473	7691	6865	7499 ^{bc}
90	60	--	30		81	79	80	78	80 ^{cd}	74	75	78	77	76 ^{cd}	7963	7324	7725	7020	7508 ^{bc}
120	120	--	--		84	83	84	81	83 ^a	80	82	86	84	83 ^a	8034	7705	8228	7733	7925 ^{ab}
150	150	--	--		86	82	84	83	84 ^a	84	90	83	82	85 ^a	8611	8475	8063	7758	8227 ^a
Variety mean**					82 ^a	80 ^c	81 ^b	79 ^c		77 ^{ab}	78 ^a	76 ^b	75 ^b		7556 ^a	7121 ^b	7212 ^b	6570 ^c	
C.V., %							1.36					5.05					6.13		

* Time of N: PF = pre-flood; PI = panicle initiation; PD = panicle differentiation.

** Means across and down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Early medium grain x nitrogen trial

Location: Vermilion Parish, Errol Lounsberry Farm

Soil Type/Analysis: Crowley silt loam; ph: 5.7; O.M. 0.77%; extractable nutrients (mg/kg): P-21, Na-94, K-39, Ca-993, Mg-231, Zn-0.96

Variety/Seeding Rate: MARS, MERC, 150 lb/A

Planting Method/Date: Water-seeded, Apr 23

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; nitrogen source, ammonium sulfate; second crop, 60 lb N/A

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: MARS, MERC, Apr 26

Water Management: Initial flood, Apr 22; drained Apr 24; reflooded, Apr 27; drained, May 13; permanent flood, May 15; harvest drainage, July 31; second crop flooded, Aug 18; second crop drained, Nov 5

Herbicides: 4 lb ai/A Stam (propanil), May 14; 1 oz Londax (bensulfuron-methyl), May 23

Insecticides: 0.6 lb ai/A Furadan (carbofuran), June 1

Fungicides: 0.5 lb ai/A Tilt (propiconazole), June 27; 0.5 lb ai/A Rovral (iprodione), July 13

Harvest: Main crop, Aug 15; second crop, Nov 23

Experimental Design: Split plot in a randomized complete block with four replications, nitrogen treatments assigned to main plots and varieties to subplots

Comments: Rapid emergence and very good seedling vigor were observed for MARS and MERC. No N deficiency was observed until panicle initiation. Days to 50% heading was increased slightly with increasing N (Table 8). MERC displayed good lodging resistance, even at high N rates. Lodging of MARS increased when N was applied above 90 lb/A. Optimum grain yields were observed at a N rate of 90 lb/A, with MARS responding positively to a split application. Grain yield of MERC was significantly higher than that of MARS.

Regrowth and second crop grain yields were fair for both varieties. Second crop grain yields were stable across main crop N rates.

Table 8. Effect of N rate and timing in main crop on performance and on main crop, second crop, and total grain yields of water-seeded early medium-grain rice varieties. Errol Lounsberry Farm, Vermilion Parish, LA. 1987.

Time of N*				Days to 50% heading				Plant height				% Lodging /type***				Main crop grain yield at 12% moisture				Second crop grain yield at 12% moisture				Total grain yield at 12% moisture																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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Experiment: Very early long grain x nitrogen trial

Location: Vermilion Parish, Errol Lounsberry Farm

Soil Type/Analysis: Crowley silt loam; ph: 5.7; O.M. 0.68%; extractable nutrients (mg/kg): P-17, Na-88, K-38, Ca-948, Mg-229, Zn-1.02

Variety/Seeding Rate: TBNT, SKBT, 150 lb/A

Planting Method/Date: Water-seeded, Apr 23

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; nitrogen source, ammonium sulfate; second crop, 60 lb N/A

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: TBNT, Apr 26; SKBT, Apr 27

Water Management: Initial flood, Apr 22; drained Apr 24; reflooded, Apr 27; drained, May 13; permanent flood, May 15; harvest drainage, July 27; second crop flooded, Aug 18; second crop drained, Nov 5

Herbicides: 4 lb ai/A Stam (propanil), May 14; 1 oz Londax (bensulfuron-methyl), May 23

Insecticides: 0.6 lb ai/A Furadan (carbofuran), June 1

Fungicides: 0.5 lb ai/A Tilt (propiconazole), June 27; 0.5 lb ai/A Rovral (iprodione), July 13

Harvest: Main crop, Aug 14; second crop, Nov 24

Experimental Design: Split plot in a randomized complete block with four replications, nitrogen treatments assigned to main plots and varieties to subplots

Comments: Seedling vigor was moderate for each variety. N deficiency was not observed until panicle initiation. Days to 50% heading was increased at high N rates (Table 9). Severe lodging in TBNT occurred above 30 lb N/A. SKBT displayed better resistance to lodging at a N rate of 90 lb/A and below. Optimum grain yields for each variety occurred at 90 lb N/A, with a positive response to split applications. SKBT significantly outyielded TBNT.

Regrowth and second crop grain yield was very low for TBNT, and fair for SKBT. Severe lodging of the TBNT main crop reduced second crop grain yields.

Table 9. Effect of N rate and timing in main crop on performance and on main crop, second crop, and total grain yields of water-seeded very early long-grain rice varieties. Errol Lounsberry Farm, Vermilion Parish, LA. 1987.

Time of N*				Days to 50% heading				Plant height				% Lodging /type**				Main crop grain yield at 12% moisture				Second crop grain yield at 12% moisture				Total grain yield at 12% moisture			
Total		N		PP	PI	PD	TBNT	SKBT	Mean	N***	TBNT	SKBT	Mean	N***	TBNT	SKBT	Mean	N***	TBNT	SKBT	Mean	N***	TBNT	SKBT	Mean		
-----lb/A-----				-----cm-----				-----b/A-----																			
0	--	--	--	70	73	72 ^e	95	87	91 ^d	0/0	0/0	5748	5782	5765 ^c	997	1340	1168 ^{bc}	6745	7122	6934 ^{bc}							
30	30	--	--	70	73	72 ^e	101	87	99 ^c	0/0	0/0	6493	6692	6593 ^{ab}	839	1286	1063 ^{bc}	7333	7979	7656 ^{ab}							
60	60	--	--	72	75	74 ^d	110	108	109 ^{ab}	47/3	20/1	6711	6741	6726 ^a	700	1343	1021 ^{bc}	7411	8084	7748 ^{ab}							
90	90	--	--	75	77	76 ^c	116	110	113 ^a	80/5	30/2	5872	6316	6094 ^{abc}	756	1399	1078 ^{bc}	6628	7716	7172 ^{abc}							
90	60	30	--	73	75	74 ^d	107	105	106 ^b	85/5	7/1	6485	6990	6737 ^a	708	1181	944 ^c	7193	8171	7682 ^{ab}							
90	60	--	30	73	76	74 ^{cd}	109	109	109 ^{ab}	80/5	5/1	6817	7122	6970 ^a	710	1288	999 ^{bc}	7527	8409	7968 ^a							
120	120	--	--	77	79	78 ^b	110	109	109 ^{ab}	90/5	50/2	5168	5401	5285 ^{cd}	901	1559	1230 ^{ab}	6068	6961	6514 ^{cd}							
150	150	--	--	78	80	79 ^a	115	110	112 ^a	87/4	52/3	4518	4699	4609 ^d	1217	1711	1464 ^a	5735	6410	6072 ^d							
Variety mean***				73 ^b	76 ^a		108 ^a	104 ^b				5977 ^b	6218 ^a		853 ^b	1388 ^a		6830 ^b	7606 ^a								
C.V., %				1.57				2.61				5.34			18.27				5.40								

* Time of N: PP = preplant; PI = panicle initiation; PD = panicle differentiation.

** Lodging rate in percent/lodging type on a scale of 0 to 5, where 1 = leaning and 5 = complete.

*** Means across and down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Early long grain x nitrogen trial

Location: Vermilion Parish, Errol Lounsberry Farm

Soil Type/Analysis: Crowley silt loam; ph: 5.9; O.M. 0.68%; extractable nutrients (mg/kg): P-15, Na-141, K-53, Ca-1266, Mg-332, Zn-0.60

Variety/Seeding Rate: LMNT, GFMT, 2201, 2203, 150 lb/A

Planting Method/Date: Water-seeded, Apr 23

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; nitrogen source, ammonium sulfate; second crop, 60 lb N/A

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: LMNT, GFMT, 2201, 2203, Apr 28

Water Management: Initial flood, Apr 22; drained Apr 24; reflooded, Apr 27; drained, May 13; permanent flood, May 15; harvest drainage, July 31; second crop flooded, Aug 18; second crop drained, Nov 5

Herbicides: 4 lb ai/A Stam (propanil), May 14; 1 oz Londax (bensulfuron-methyl), May 23

Insecticides: 0.6 lb ai/A Furadan (carbofuran), June 1

Fungicides: 0.5 lb ai/A, Tilt (propiconazole), June 27; 0.5 lb ai/A Rovral (iprodione), July 13

Harvest: Main crop, Aug 15; second crop was not harvested

Experimental Design: Split plot in a randomized complete block with four replications, nitrogen treatments assigned to main plots and varieties to subplots

Comments: Seedling vigor and emergence were good for all varieties. N deficiency was not observed until panicle initiation. Days to 50% heading was increased with increasing N (Table 10). Optimum grain yields for all varieties resulted from a rate of 90 lb N/A. LMNT, GFMT, and 2201 showed a positive response to a split application. Grain yield of 2201 was significantly higher than those of the other varieties.

Second crop regrowth was fair. Very cool temperatures during reproductive growth limited grain formation, precluding second crop grain yield determinations.

Table 10. Effect of N rate and timing on performance of water-seeded early long-grain rice varieties. Errol Lounsberry Farm, Vermillion Parish, LA. 1987.

Time of N*				Days to 50% heading				Plant height				Grain yield at 12% moisture					
Total		PP	PI	PD	LMNT	GFMT	2201	2203	N** Mean	LMNT	GFMT	2201	2203	N** Mean			
N		lb/A				cm				lb/A							
0	--	--	--	--	74	72	72	71	72 ^f	69	75	71	69	71 ^c			
30	30	--	--	--	75	74	74	72	74 ^e	74	76	73	76	75 ^c			
60	60	--	--	--	77	76	76	74	76 ^d	79	83	81	77	80 ^b			
90	90	--	--	--	79	78	78	75	78 ^c	81	87	85	83	84 ^{ab}			
90	60	30	--	--	77	76	76	74	76 ^d	81	81	83	85	83 ^{ab}			
90	60	--	30	--	78	77	76	76	77 ^d	81	82	82	82	82 ^b			
120	120	--	--	--	81	79	79	77	79 ^b	83	86	89	80	85 ^{ab}			
150	150	--	--	--	82	80	80	79	80 ^a	86	88	84	90	87 ^a			
Variety mean**					78 ^a	77 ^b	76 ^b	75 ^c		79 ^b	82 ^a	81 ^{ab}	80 ^{ab}				
C.V., %							0.98					4.89					
												7219 ^a	7155 ^a				
												4.16					

* Time of N: PP = preplant; PI = panicle initiation; PD = panicle differentiation.

** Means across and down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Midseason specialty long grain x nitrogen trial

Location: Vermilion Parish, Errol Lounsberry Farm

Soil Type/Analysis: Crowley silt loam; ph: 5.6; O.M. 0.72%; extractable nutrients (mg/kg): P-20, Na-81, K-38, Ca-847, Mg-197, Zn-1.39

Variety/Seeding Rate: DLLA, 2186, 150 lb/A

Planting Method/Date: Water-seeded, Apr 23

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; nitrogen source, ammonium sulfate; second crop, 60 lb N/A

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: DLLA, 2186, Apr 26

Water Management: Initial flood, Apr 22; drained Apr 24; reflooded, Apr 27; drained, May 13; permanent flood, May 15; harvest drainage, Aug 7; second crop flooded, Aug 18; second crop drained, Nov 5

Herbicides: 4 lb ai/A Stam (propanil), May 14; 1 oz Londax (bensulfuron-methyl), May 23

Insecticides: 0.6 lb ai/A Furadan (carbofuran), June 1

Fungicides: 0.5 lb ai/A, Tilt (propiconazole), June 27; 0.5 lb ai/A Rovral (iprodione), July 13

Harvest: Main crop, Aug 19

Experimental Design: Split plot in a randomized complete block with four replications, nitrogen treatments assigned to main plots and varieties to subplots

Comments: Moderate seedling vigor was observed for DLLA and 2186. Very slight N deficiency was observed at panicle initiation. Days to 50% heading was increased somewhat by increasing N (Table 11). Severe lodging occurred at all N rates for both varieties, resulting in low grain yields.

Second crop yields were not determined.

Table 11. Effect of N rate and timing on performance and grain yields of water-seeded midseason speciality long-grain rice varieties. Errol Lounsberry Farm, Vermilion Parish, LA. 1987.

Total N	Time of N*			Days to 50% heading			Plant height****			% Lodging/ type**			Grain yield at 12% moisture		
	PP	PI	PD	DLLA	2186	N*** Mean	DLLA	2186	N*** Mean	DLLA	2186	N*** Mean	DLLA	2186	N*** Mean
	-----lb/A-----			-----cm-----			-----lb/A-----			-----lb/A-----			-----lb/A-----		
0	--	--	--	84	84	84 ^e	--	--	--	77/4	7/1	4642	5318	4980 ^a	
30	30	--	--	85	85	85 ^{de}	--	--	--	90/4	40/2	3623	4472	4047 ^b	
60	60	--	--	85	86	85 ^{cd}	--	--	--	90/4	90/4	2955	3566	3261 ^{cd}	
90	90	--	--	86	87	87 ^b	--	--	--	90/4	90/4	2828	2879	2854 ^{de}	
90	60	30	--	86	86	86 ^{bc}	--	--	--	90/4	90/5	2873	2952	2912 ^{cde}	
90	60	--	30	86	86	86 ^{bc}	--	--	--	90/4	90/4	3388	3485	3437 ^c	
120	120	--	--	87	88	88 ^a	--	--	--	90/4	90/4	2414	2755	2585 ^e	
150	150	--	--	88	89	88 ^a	--	--	--	90/4	90/5	2620	2784	2702 ^e	
Variety mean***				86 ^a	86 ^a							3168 ^b	3526 ^a		
C.V., %					0.89								11.40		

* Time of N: PP = preplant; PI = panicle initiation; PD = panicle differentiation.

** Lodging rate in percent/lodging type on a scale of 0 to 5, where 1 = leaning and 5 = complete.

*** Means across and down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

**** Due to severe lodging, plant height was not recorded.

EFFECT OF N RATE AND TIMING ON PERFORMANCE, GRAIN YIELD AND YIELD COMPONENTS OF LEMONT RICE

P.K. Bollich, W.J. Leonards, Jr., S.M. Rawls, and D.M. Walker

INTRODUCTION

Nitrogen (N) fertilization greatly influences the yield potential of rice. The N requirements vary among rice varieties and may also differ due to environment. This requirement is also affected by management. Placement and timing of fertilizer N application, and water management both impact N efficiency.

There are a number of approaches to fertilizer N management, depending on the cultural system used. The total N requirement may be applied preplant and incorporated prior to flooding in the water seeded, continuous or pinpoint flood cultural system, or preplant in the dry-seeded cultural system. In some situations it may be desirable to apply a split application of N in either system. Split applications may be necessary when there is a lack of precision in placement of large amounts of fertilizer product. Difficulties or delays in flooding large areas in a short period of time may necessitate the use of split applications. Research has shown that there is generally no advantage in using split applications when proper management practices are followed. Inadequate amounts of basal N or improperly timed topdress applications could actually lead to decreased grain yield. When applying split applications it is important to supply enough basal N to maintain the rice plant through the tillering stage and into early reproductive growth. Topdress applications of N need to be applied before severe N deficiency occurs. This approach usually results in grain yields comparable to those of the single preplant or preplant N application. Multiple topdress applications should be avoided in order to reduce N inefficiency and input cost.

Single preplant or preplant N applications, and two-way or multiple split applications have been practiced commercially in rice producing areas of the southern United States. The objectives of this study are to 1) determine the effect of N rate and time of application on performance, grain yield, and grain yield components of Lemont rice in different environments and in both cultural systems, and 2) compare the various approaches to fertilizer management.

MATERIALS AND METHODS

The long-grain semidwarf variety Lemont was used in all experiments. Nitrogen rates of 0, 30, 60, 90, 120, 150, and 180 lb/A were banded approximately 2 inches deep 1 to 2 days prior to flooding in the water-seeded experiments. In soils requiring P and K, approximately 60 lb/A P_2O_5 and K_2O were also banded with N as ammonium sulfate. The 90 and 120 lb N/A rates were also split to provide two-thirds to three-fourths preplant with the remaining N being applied at panicle initiation (green ring). The 180 lb N/A rate was also applied as a three-way split, providing one-half preplant, one-fourth at panicle differentiation (panicle 2 mm), and one-fourth 14 days after panicle differentiation. In drill-seeded experiments, basal N treatments were applied

as a broadcast application prior to establishment of the permanent flood, and the split applications were applied as in the water-seeded experiments.

Water-seeded experiments were seeded at the rate of 150 lb/A with presoaked seed. After 3 to 4 days, the experiments were drained briefly to promote seedling anchorage. A permanent flood was established 2 to 3 days after drainage, never allowing the soil to dry.

In drill-seeded experiments, Lemont was seeded at 100 lb/A and flushed periodically until the permanent flood was established (4 to 5 weeks after planting). Pest control (weeds, insects, disease), when necessary, was practiced according to current recommendations. Individual whole plots were combine-harvested at field maturity. Days to 50% heading, plant height, lodging, grain moisture, and grain yield were measured. Yield components were determined.

SUMMARY AND CONCLUSIONS

Field experiments were conducted at the Rice Research Station (RRS) and in East Carroll, Morehouse, and Rapides parishes to determine the influence of N rate and timing on performance, grain yield, and yield components of Lemont rice.

Nitrogen requirements for optimum grain yield in the water-seeded experiments at the RRS and in Morehouse were similar. A rate of 90 to 120 lb N/A was required, with little difference being observed when N was applied as either a single preplant or split application. The 3-way split of 180 lb/N resulted in similar yields. Most yield components responded positively to increasing N. Number of sterile florets increased significantly with increasing N, although the number of filled grains remained relatively constant. A maximum N rate of 180 lb/A was required for highest grain yields in Rapides, indicating poor uptake and efficiency of applied N. Increasing N resulted in small changes in yield components.

A N rate of 180 lb/A was also required for optimum yield in the drill-seeded experiment in East Carroll. Grain yield responses to a single application of 180 lb N/A and a 3-way split of 180 lb/A were similar. Number of sterile florets increased as N rate increased. There was little change in the number of filled grains. Grain yield of the drill-seeded test in Rapides was low, and response to applied N was poor. Yield components were generally not influenced by N application, indicating poor uptake and efficiency of applied N. Number of sterile florets were significantly higher at 0 N.

Experiments: Nitrogen rate x timing study

Location: Rice Research Station

Soil Type/Analysis: Crowley silt loam; ph: 6.1; O.M.: 0.77%; extractable nutrients (mg/kg): P-36, Na-46, K-53, Ca-940, Mg-169, Zn-0.74

Variety/Seeding Rate: LMNT, 150 lb/A

Planting Method/Date: Water-seeded, Apr 9

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; nitrogen source, ammonium sulfate; second crop, 60 lb N/A

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: Apr 18

Water Management: Initial flood, Apr 9; drained, Apr 14; reflooded, Apr 16; drained, Apr 25; reflooded, Apr 28; drained, May 10; permanent flood, May 12; harvest drainage, July 24; second crop flooded, Aug 14; second crop drained, Oct 18

Herbicides: 4 lb ai/A Stam (propanil), Apr 27; 3 lb ai/A Stam + 0.75 Basagran (bentazon), May 11

Insecticides: 0.6 lb ai/A Furadan (carbofuran), May 27

Fungicides: 0.4 lb ai/A Tilt (propiconazole), June 22

Harvest: Main crop, Aug 6, second crop was not harvested

Experimental Design: Randomized complete block with four replications of 10 N rate x timing combinations

Comments: Cool temperatures delayed emergence and slowed seedling growth. A N response was observed 3 weeks after emergence. Moderate N deficiency developed at 0 and 30 lb N/A rates 5 weeks after emergence. Slight N deficiency occurred at a 60 lb N/A rate. Days to 50% heading increased with increasing N, especially when N was applied preplant as a single application (Table 1). Highest grain yields were observed with a N application of 90 to 120 lb/A. A similar yield was measured with a 3-way split of 180 lb N/A.

Yield component data was not determined. Slow regrowth and cool temperatures occurring during reproductive growth also prevented second crop production.

Table 1. Effect of N rate and timing on performance, grain yield, and yield components of water-seeded Lemont Rice. Rice Research Station, Crowley, LA. 1987.

Total N	Total of N*				Days to 50% heading	Plant height (cm)	Grain yield at 12% moisture (lb/A)
	PP	PI	PD	PD + 14 days			
0	--	--	--	--	83 ^e	60 ^g	4488 ^d
30	30	--	--	--	83 ^e	69 ^f	6525 ^c
60	60	--	--	--	84 ^d	75 ^e	7824 ^{ab}
90	90	--	--	--	85 ^{cd}	78 ^{cde}	7997 ^{ab}
90	60	30	--	--	84 ^d	77 ^{de}	8207 ^a
120	120	--	--	--	88 ^b	82 ^{abc}	7926 ^{ab}
120	90	30	--	--	88 ^b	80 ^{cd}	8119 ^a
150	150	--	--	--	90 ^a	85 ^a	7561 ^{ab}
180	180	--	--	--	91 ^a	85 ^{ab}	7309 ^b
180	100	--	40	40	86 ^c	81 ^{bc}	8105 ^a
C.V.%					1.09	3.04	5.84

* Time of N: PP = preplant; PI = panicle initiation; and PD = panicle differentiation.

Means down columns followed by the same letter are not significantly different ($P < 0.05$) according to Duncan's multiple range test.

Experiment: Nitrogen rate x timing study

Location: East Carroll Parish, Buford Perry Farm

Soil Type/Analysis: Sharkey clay; ph: 6.2; O.M.: 1.65%; extractable nutrients (mg/kg): P- 137, Na-63, K-477, Ca-5131, Mg-1168, Zn-6.14

Variety/Seeding Rate: LMNT, 100 lb/A

Planting Method/Date: Drill-seeded, Apr 29

Fertilization: Nitrogen source, ammonium sulfate

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: May 13

Water Management: Flushed, May 5, May 17, May 30; permanent flood, June 9; harvest drainage, Aug 31

Herbicides: 4 lb ai/A Stam (propanil) + 0.25 lb ai/A Brominal (bromoxynil), May 21; 4 lb ai/A Stam, June 9; 0.75 ai/A Basagran (bentazon), June 26

Insecticides: 0.6 lb ai/A Furadan (carbofuran), July 8

Fungicides: 0.5 lb ai/A Benlate (benomyl), Aug 13

Harvest: Sep 15

Experimental Design: Randomized complete block with four replications of 10 N rate x timing combinations

Comments: Emergence and stand establishment were hindered by nonuniform seed placement and very wet conditions following planting. Days to 50% heading increased somewhat with increasing N (Table 2). An unusually high rate of N (180 lb/A) was required for optimum yield. A wet seedbed during the time of preflood N application probably contributed to loss of N, thereby requiring higher N for optimum grain yields. N applications of 120 lb/A and greater resulted in grain yields above 8000 lb/A.

An increase in N increased whole plant weight, number of panicles, panicle weight, and grain weight. Number of sterile florets also increased with increasing N. Number of filled grains remained relatively constant across rates of N.

Table 2. Effect of N rate and timing on performance, grain yield, and yield components of drill-seeded Lemont rice. Buford Perry Farm, East Carroll Parish. 1987.

N	Total of N*				Days to 50% heading	Plant height (cm)	Grain yield at 12% moisture (lb/A)	Whole plant (g/3 ft ²)	Panicles (no/3 ft ²)	Panicle weight --- (g/3 ft ²)	Grain weight (g/3 ft ²)	Panicle weight --- (g/20 panicles)	Grain weight (g/20 panicles)	Sterile florets -- (no/20 panicles)	Filled grains
	PF	PI	PD	PD + 14 days											
0	--	--	--	--	83 ^d	74 ^e	6338 ^e	385 ^d	73 ^d	221 ^d	205 ^d	68 ^a	63 ^a	300 ^c	2358 ^a
30	30	--	--	--	84 ^{cd}	80 ^{de}	6837 ^e	471 ^c	89 ^{cd}	260 ^{cd}	240 ^{cd}	60 ^{ab}	56 ^{ab}	289 ^c	2108 ^{abc}
60	60	--	--	--	84 ^{cd}	83 ^{cd}	7648 ^d	510 ^{bc}	94 ^c	283 ^{bc}	263 ^{bc}	60 ^b	55 ^{ab}	282 ^c	2076 ^{abc}
90	90	--	--	--	84 ^{cd}	84 ^{bcd}	7870 ^{bcd}	530 ^{bc}	111 ^b	299 ^{abc}	277 ^{abc}	54 ^b	51 ^b	278 ^c	1857 ^{bc}
90	60	30	--	--	85 ^{bcd}	84 ^{bcd}	7769 ^{cd}	599 ^{ab}	112 ^b	332 ^{ab}	307 ^{ab}	57 ^b	53 ^b	333 ^{bc}	2044 ^{abc}
120	120	--	--	--	87 ^{abc}	91 ^{cd}	8424 ^{abc}	589 ^{ab}	125 ^{ab}	341 ^a	313 ^a	58 ^b	54 ^b	338 ^{bc}	2044 ^{abc}
120	90	30	--	--	87 ^{abc}	82 ^{cd}	7847 ^{bcd}	594 ^{ab}	114 ^b	327 ^{ab}	297 ^{ab}	55 ^b	47 ^b	388 ^{bc}	1789 ^c
150	150	--	--	--	89 ^{ab}	89 ^{abc}	8278 ^{abcd}	597 ^{ab}	115 ^b	326 ^{ab}	298 ^{ab}	60 ^{ab}	56 ^{ab}	343 ^{bc}	2150 ^{ab}
180	180	--	--	--	89 ^a	94 ^a	8530 ^{ab}	664 ^a	139 ^a	340 ^a	313 ^a	57 ^b	52 ^b	448 ^{ab}	2106 ^{abc}
180	100	--	40	40	86 ^{abcd}	89 ^{abc}	8700 ^a	624 ^a	119 ^b	346 ^a	315 ^a	59 ^b	53 ^b	470 ^a	2025 ^{abc}
C.V. %					2.39	5.24	5.80	9.96	10.17	10.54	10.28	9.01	10.13	22.75	9.80

* Time of N: PF = pre-flood; PI = panicle initiation; and PD = panicle differentiation.

Means down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Nitrogen rate x timing study

Location: Rapides Parish, Bollich Farm

Soil Type/Analysis: Moreland clay; ph: 6.5; O.M.: 1.78%; extractable nutrients (mg/kg): P-170, Na-44, K-345, Ca-3894, Mg-1081, Zn-2.99

Variety/Seeding Rate: LMNT, 100 lb/A

Planting Method/Date: Drill-seeded, June 1

Fertilization: Nitrogen source, ammonium sulfate

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: June 12

Water Management: Flushed, June 4, June 25; permanent flood, July 6; harvest drainage, Sep 20

Herbicides: 3 lb ai/A Stam (propanil), June 21; 3.75 lb ai/A Stam + 0.25 lb ai/A Bucril (brominal), July 4; 1 oz ai/A Londax (bensulfuron-methyl), July 20

Insecticides: 0.6 lb ai/A Furadan (carbofuran), July 13; 0.25 lb ai/A methyl parathion, Sep 2

Fungicides: 0.4 lb ai/A Tilt (propiconazole), Aug 16; 0.5 lb ai/A Benlate (benomyl), Sep 2

Harvest: Oct 5

Experimental Design: Randomized complete block with four replications of 10 N rate x timing combinations

Comments: Emergence of LMNT was somewhat slow, although high temperatures should have enhanced germination and emergence. Nitrogen deficiency was evident before preflood N was applied. Response to applied N was observed within 7 days of permanent flood establishment. Days to 50% heading was not influenced by applied N (Table 3). Efficiency of uptake and utilization was poor, as indicated by poor plant growth and low grain yields. Maximum grain yields occurred at unusually high rates of N.

Total plant biomass, panicle number and weight, and grain weight increased with increasing N. The response, however, was much lower than expected.

Table 3. Effect of N rate and timing on performance, grain yield, and yield components of drill-seeded Lemont rice. Bollich Farm, Rapides parish. 1987.

N	Total of N*				Days to 50% heading	Plant height (cm)	Grain yield at 12% moisture (lb/A)	Whole plant (g/3 ft ²)	Panicles (no/3 ft ²)	Panicle weight --- (g/3 ft ²)	Grain weight --- (g/20 panicles)	Panicle weight --- (g/20 panicles)	Sterile florets --- (no/20 panicles)	Filled grains
	PF	PI	PD	PD + 14 days										
0	--	--	--	--	83 ^{ab}	75 ^{ab}	3343 ^c	316 ^c	76 ^b	142 ^b	122 ^b	42 ^{ab}	539 ^a	1482 ^{ab}
30	30	--	--	--	82 ^b	76 ^{ab}	4083 ^b	345 ^{bc}	89 ^{ab}	156 ^b	137 ^b	38 ^{ab}	283 ^b	1511 ^{ab}
60	60	--	--	--	83 ^{ab}	75 ^{ab}	4044 ^b	393 ^{abc}	108 ^{ab}	171 ^{ab}	152 ^{ab}	32 ^b	253 ^b	1226 ^b
90	90	--	--	--	85 ^a	79 ^{ab}	4463 ^{ab}	429 ^{abc}	106 ^{ab}	184 ^{ab}	163 ^{ab}	35 ^{ab}	299 ^b	1320 ^{ab}
90	60	30	--	--	83 ^{ab}	78 ^{ab}	4431 ^{ab}	409 ^{abc}	104 ^{ab}	177 ^{ab}	157 ^{ab}	35 ^{ab}	292 ^b	1320 ^{ab}
120	120	--	--	--	85 ^{ab}	78 ^{ab}	4219 ^{ab}	437 ^{abc}	107 ^{ab}	178 ^{ab}	158 ^{ab}	38 ^{ab}	261 ^b	1411 ^{ab}
120	90	30	--	--	83 ^{ab}	74 ^b	4196 ^{ab}	362 ^{abc}	99 ^{ab}	156 ^b	137 ^b	34 ^{ab}	334 ^b	1268 ^b
150	150	--	--	--	85 ^a	80 ^a	4609 ^{ab}	429 ^{abc}	113 ^{ab}	169 ^{ab}	145 ^b	40 ^{ab}	306 ^b	1491 ^{ab}
180	180	--	--	--	85 ^a	79 ^{ab}	4573 ^{ab}	474 ^{ab}	122 ^a	191 ^{ab}	163 ^{ab}	36 ^{ab}	388 ^{ab}	1318 ^{ab}
180	100	--	40	40	84 ^{ab}	79 ^{ab}	4829 ^a	484 ^a	114 ^a	219 ^a	194 ^a	45 ^a	298 ^b	1699 ^a
C.V. %					2.22	4.25	10.18	19.76	21.55	17.34	18.74	18.73	40.40	17.32

* Time of N: PF = pre-flood; PI = panicle initiation; and PD = panicle differentiation.
Means down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Nitrogen rate x timing study

Location: Rapides Parish, Bollich Farm

Soil Type/Analysis: Moreland clay; ph: 6.8; O.M.: 1.65%; extractable nutrients (mg/kg): P-162, Na-41, K-341, Ca-3710, Mg-1052, Zn-3.12

Variety/Seeding Rate: LMNT, 150 lb/A

Planting Method/Date: Water-seeded, June 3

Fertilization: Nitrogen source, ammonium sulfate

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: June 8

Water Management: Initial flood, June 3; drained, June 5; reflooded, June 9; drained, June 30; permanent flood, July 6; harvest drainage, Sep 15

Herbicides: 3 lb ai/A Stam (propanil), June 21; 3.75 lb ai/A Stam + 0.25 lb ai/A Buctril (brominal), July 4; 1 oz ai/A Londax (bensulfuron-methyl), July 20

Insecticides: 0.6 lb ai/A Furadan (carbofuran), July 13; 0.25 lb ai/A methyl parathion, Sep 2

Fungicides: 0.4 lb ai/A Tilt (propiconazole), Aug 16; 0.5 lb ai/A Benlate (benomyl), Sep 2

Harvest: Oct 5

Experimental Design: Randomized complete block with four replications of 10 N rate x timing combinations

Comments: Emergence of LMNT was very rapid, and was probably influenced by high temperatures during seedling growth. Nitrogen deficiency in the control and low N treatments occurred soon after emergence. Days to 50% heading was influenced only when N was not applied, being delayed by 6 days (Table 4). Plant height response to increasing N was more evident than in the drill-seeded experiment. Maximum grain yield occurred at a N rate of 180 lbs/A, applied as a 3-way split.

Total plant biomass and panicle number and weight, increased with increasing N. Numbers of sterile florets and filled grains were not influenced by increasing N.

Table 4. Effect of N rate and timing on performance, grain yield, and yield components of water-seeded Lemont rice. Bollich Farm, Rapides parish. 1987.

N	Total of N*				Plant height (cm)	Grain yield at 12% moisture (lb/A)	Whole plant (g/3 ft ²)	Panicles (no/3 ft ²)	Panicle weight --- (g/3 ft ²)	Grain weight --- (g/3 ft ²)	Panicle weight --- (g/20 panicles)	Grain weight --- (g/20 panicles)	Sterile florets --- (no/20 panicles)	Filled grains
	PP	PI	PD	PD + 14 days										
0	--	--	--	--	64 ^f	3230 ^e	210 ^e	110 ^c	116 ^c	98 ^d	28 ^{ab}	26 ^{ab}	230 ^a	1115 ^{ab}
30	30	--	--	--	68 ^f	3992 ^d	236 ^e	110 ^{bc}	117 ^c	98 ^d	22 ^b	20 ^{ab}	189 ^a	859 ^b
60	60	--	--	--	74 ^e	4893 ^c	316 ^{cd}	141 ^{abc}	165 ^{ab}	145 ^{bc}	26 ^{ab}	24 ^{ab}	190 ^a	977 ^{ab}
90	90	--	--	--	79 ^{cd}	5723 ^b	331 ^{bcd}	130 ^{abc}	170 ^{ab}	150 ^{bc}	27 ^{ab}	25 ^{ab}	227 ^a	1010 ^{ab}
90	60	30	--	--	75 ^{de}	5173 ^c	306 ^d	140 ^{abc}	159 ^b	136 ^c	28 ^{ab}	26 ^{ab}	248 ^a	1072 ^{ab}
120	120	--	--	--	78 ^{cde}	5902 ^b	375 ^{abc}	155 ^a	190 ^{ab}	164 ^{bc}	26 ^{ab}	24 ^{ab}	207 ^a	969 ^{ab}
120	90	30	--	--	80 ^{bc}	6129 ^b	363 ^{abcd}	150 ^a	187 ^{ab}	164 ^{bc}	24 ^{ab}	22 ^{ab}	225 ^a	915 ^{ab}
150	150	--	--	--	84 ^{ab}	6269 ^{ab}	424 ^a	159 ^a	201 ^a	181 ^{ab}	25 ^{ab}	23 ^{ab}	193 ^a	980 ^{ab}
180	180	--	--	--	85 ^a	6262 ^{ab}	398 ^{ab}	146 ^{ab}	191 ^{ab}	170 ^{abc}	30 ^a	28 ^a	223 ^a	1152 ^a
180	100	--	40	40	80 ^{abc}	6753 ^a	418 ^a	160 ^a	198 ^{ab}	200 ^a	29 ^{ab}	26 ^{ab}	184 ^a	1023 ^{ab}
C.V. %					3.95	6.29	12.70	14.55	14.84	14.82	16.80	17.31	23.66	16.03

* Time of N: PP = preplant; PI = panicle initiation; and PD = panicle differentiation.

Means down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

Experiment: Nitrogen rate x timing study

Location: Morehouse Parish, Zaunbrecher Farm

Soil Type/Analysis: Hebert silty clay loam; ph: 5.6; O.M.: 1.69%;
extractable nutrients (mg/kg): P-89, Na-89, K-250,
Ca-2225, Mg-672, Zn-2.50

Variety/Seeding Rate: LMNT, 150 lb/A

Planting Method/Date: Water-seeded, Apr 30

Fertilization: Nitrogen source, ammonium sulfate

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: May 6

Water Management: Initial flood, Apr 29; drained, May 3; reflooded, May 6;
drained, May 17; permanent flood, May 20; harvest drainage,
Aug 12

Herbicides: 4 lb ai/A Stam (propanil), May 20

Insecticides: None

Fungicides: 0.5 lb ai/A Benlate (benomyl), July 17

Harvest: Aug 31

Experimental Design: Randomized complete block with four replications of 10
N rate x timing combinations

Comments: Good seedling vigor and rapid emergence was observed with LMNT.
Nitrogen deficiency symptoms in the 0 and 30 lb/A rate occurred 2 and 3
weeks after emergence, respectively. Increasing N increased days to 50%
heading (Table 5). Optimum grain yields were observed when a total of
120 lbs N/A was applied, either as a single preplant application or a 2-
way split. The 3-way split resulted in a similar grain yield.

Total plant biomass, panicle number and weight, grain weight, and
the number of sterile florets increased with increasing N.

Table 5. Effect of N rate and timing on performance, grain yield, and yield components of water-seeded Lemont rice. Zaunbrecher Farm, Morehouse parish. 1987.

N	Total of N*				Days to 50% heading	Plant height (cm)	Grain yield at 12% moisture (lb/A)	Whole plant (g/3 ft ²)	Panicles (no/3 ft ²)	Panicle weight --- (g/3 ft ²)	Grain weight --- (g/3 ft ²)	Panicle weight --- (g/20 panicles)	Grain weight --- (g/20 panicles)	Sterile florets --- (no/20 panicles)	Filled grains
	PP	PI	PD	PD + 14 days											
0	--	--	--	--	78 ^f	52 ^f	4991 ^d	309 ^e	135 ^d	174 ^e	159 ^e	29 ^c	27 ^b	156 ^e	1056 ^d
30	30	--	--	--	77 ^f	55 ^e	6462 ^c	425 ^d	161 ^c	242 ^{cd}	226 ^c	30 ^{bc}	29 ^{ab}	128 ^e	1104 ^{cd}
60	60	--	--	--	79 ^e	64 ^d	7651 ^{ab}	479 ^{cd}	166 ^c	272 ^{bc}	253 ^{abc}	35 ^{ab}	34 ^a	149 ^e	1303 ^{abc}
90	90	--	--	--	82 ^c	67 ^d	7890 ^{ab}	499 ^{bc}	174 ^{bc}	271 ^{bc}	250 ^{bc}	34 ^{abc}	33 ^{ab}	210 ^{cde}	1284 ^{abcd}
90	60	30	--	--	81 ^d	67 ^d	7722 ^{ab}	517 ^{abc}	185 ^{ab}	285 ^{ab}	263 ^{ab}	30 ^{bc}	28 ^b	183 ^{de}	1116 ^{abcd}
120	120	--	--	--	84 ^b	74 ^{abc}	8084 ^a	552 ^{ab}	193 ^{ab}	277 ^b	250 ^{bc}	31 ^{abc}	29 ^{ab}	270 ^{bc}	1167 ^{abcd}
120	90	30	--	--	84 ^b	71 ^c	8205 ^a	540 ^{abc}	198 ^a	278 ^b	252 ^{bc}	34 ^{abc}	32 ^{ab}	259 ^{bcd}	1352 ^{ab}
150	150	--	--	--	86 ^a	76 ^{ab}	7733 ^{ab}	537 ^{abc}	200 ^a	254 ^{bc}	225 ^c	30 ^{abc}	28 ^b	437 ^a	1154 ^{abcd}
180	180	--	--	--	87 ^a	77 ^a	7255 ^b	518 ^{abc}	180 ^{abc}	217 ^d	191 ^d	33 ^{abc}	31 ^{ab}	433 ^a	1299 ^{abc}
180	100	--	40	40	84 ^b	73 ^{bc}	8336 ^a	576 ^a	190 ^{ab}	310 ^a	283 ^a	36 ^a	33 ^{ab}	301 ^b	1371 ^a
C.V. %					0.96	3.26	5.83	7.65	7.78	7.96	8.14	11.11	11.79	20.64	12.01

* Time of N: PP = preplant; PI = panicle initiation; and PD = panicle differentiation.

Means down columns followed by the same letter are not significantly different (P<0.05) according to Duncan's multiple range test.

COMPARATIVE EFFECTS OF UREA AND DICYANDIAMIDE ON PERFORMANCE AND GRAIN YIELD OF DRILL-SEEDED LEMONT RICE

P.K. Bollich, W.J. Leonards, Jr., S.M. Rawls, and D.M. Walker

INTRODUCTION

Uptake and efficiency of applied nitrogen (N) greatly influences grain yields of rice. Optimum grain yields generally depend on the correct amount of applied N, and efficiency of N uptake. Improper management of fertilizer N may lead to denitrification, volatilization, and leaching, resulting in large losses of applied N and causing reduced yields.

Rate and timing of applied N depends primarily on the cultural system used. In water-seeded rice, large amounts of fertilizer N can be preplant incorporated into a dry soil followed by immediate flooding. This N will remain in a form available to the rice plant if the soil is maintained in a flooded condition. Large amounts of preplant N cannot be maintained or effectively utilized in the dry-seeded system. Intermittent wetting and drying cycles in the dry-seeded system encourages the nitrification process, resulting in N loss once the permanent flood is established. An effective nitrification inhibitor could maintain preplant N in a stable, plant available form, thereby eliminating early seedling N deficiency usually encountered when preplant N is not applied.

The objective of the 1987 study was to determine the relative efficiency in the dry-seeded system of dicyandiamide (DCD) in relation to urea and the influence of time of application on relative efficiency of the two N sources in the southwest Louisiana rice producing area.

MATERIALS AND METHODS

The DCD (10%) used was provided by SKW Trostberg. Preplant N treatments of 0, 30, 60, 90, 120, and 150 lb/A were banded for the urea and DCD materials in the drill-seeded experiment. Approximately 60 lb/A P_2O_5 and K_2O were also banded with the preplant N. Preflood N treatments were applied as a broadcast application prior to establishment of the permanent flood. Urea was also applied in 2- and 3-way splits. The 2-way split consisted of 2/3 of the total N requirement applied preflood, followed by a topdressing application of the remaining 1/3 at panicle initiation (PI). The 3-way split consisted of 50% of the total N requirement applied preflood, followed by a topdressing application of 25% of the remaining N at panicle differentiation (PD) and a topdressing of 25% at PD plus 10 days.

Lemont was seeded at 100 lb/A and flushed periodically until the permanent flood was established (6 weeks after planting). Pest control (weeds and insects) was practiced according to current recommendations. Individual whole plots were combine-harvested at field maturity. Days to 50% heading, plant height, grain moisture, and grain yield were measured.

SUMMARY AND CONCLUSIONS

A field experiment was conducted to study the influence of N source and time of application on the performance and grain yield of dry-seeded Lemont rice. DCD and urea applied preflood, and a urea 2-way split consisting of 2/3 of the N requirement being applied preflood and the remainder at PI were all similar in performance. The 3-way urea split was not efficiently utilized, resulting in decreased grain yield. Preplant urea was very inefficient and resulted in the lowest grain yield. Preplant DCD was more efficiently utilized than preplant urea, indicating an advantage from the nitrification inhibitor. No yield advantage was realized with the DCD when compared with a preflood urea application coupled with proper water management.

Experiment: Nitrogen source x time and rate study

Location: Rice Research Station

Soil Type/Analysis: Crowley silt loam; pH: 6.1; O.M.: 0.77%; extractable nutrients (ppm): P-36, Na-46, K-53, Ca-925, Mg-169, Zn-0.74

Variety/Seeding Rate: LMNT, 100 lb/A

Planting Method/Date: Drill-seeded, Apr 2

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; nitrogen source, DCD, urea

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: Apr 18

Water Management: Flushed, Apr 16, Apr 24, Apr 29; permanent flood, May 12; harvest drainage, Aug 3

Herbicides: 3 lb ai/A Stam (propanil) + 1 1/2 pt Basagran (bentazon), May 11

Insecticides: 0.6 lb ai/A Furadan (carbofuran), May 27

Fungicides: None

Harvest: Aug 18

Experimental Design: Split plot in a randomized complete block with four replications. Nitrogen rates assigned to main plots and N source and time to subplots

Comments: Response to applied N was visible 2 weeks after emergence. Urea or DCD applied preflood increased days to 50% heading (Table 1). Preflood N treatments were more efficiently utilized, increasing plant height and grain yield. Preplant DCD was more efficiently utilized than preplant urea, and increased grain yield. DCD applied preflood gave no yield advantage when compared with urea preflood. Performance of single applications of urea or DCD and the urea 2-way split were similar. The urea 2-way split was superior to the urea 3-way split.

Table 1. Effects of N source, rate, and timing on performance and grain yield of drill-seeded Lemont rice. Rice Research Station, Crowley, LA. 1987.

Source and time of application*	Days to 50% heading							Plant height							Grain yield at 12% moisture							Source time mean**	
	Total N							Source time							Total N								Source time mean**
	lb/A							cm							lb/A								
	0	30	60	90	120	150	mean**	0	30	60	90	120	150	mean**	0	30	60	90	120	150			
Urea: 100% PP	82	83	81	82	82	83	^d	66	66	67	71	72	74	^d	3746	3514	4172	5492	5261	5510	^d		
Urea: 100% PF	82	83	84	85	86	88	^{85^a}	66	70	74	79	82	87	^{76^a}	3746	4670	5807	6356	6965	7098	^{4616^a}		
Urea: 50% PF + 25% PD	82	83	83	83	84	84	^{83^c}	66	66	71	73	75	79	^{72^c}	3746	3883	4583	5664	6287	6790	^{5774^c}		
+ 25% PD + 10 days																				^{5159^c}			
Urea: 67% PF + 33% PI	82	83	83	84	85	86	^{84^b}	64	68	71	77	80	85	^{74^b}	3207	4403	5417	6336	7098	7151	^{5602^{ab}}		
DCD: 100% PP	82	82	81	83	84	84	^{83^c}	64	66	71	72	80	81	^{72^c}	3207	4083	5307	5172	6950	7505	^{5371^{bc}}		
DCD: 100% PF	82	83	85	87	86	87	^{85^a}	64	71	73	80	83	88	^{77^c}	3207	4425	5390	6560	6629	7406	^{5603^{ab}}		
N rate mean**	82 ^c	83 ^{bc}	83 ^{bc}	84 ^{ab}	85 ^a	85 ^a		65 ^f	68 ^e	71 ^d	75 ^c	79 ^b	82 ^a		3477 ^d	4163 ^d	5113 ^c	5930 ^b	6532 ^{ab}	6910 ^a			
C.V., %																					9.51		
																					3.17		
																					1.00		

* Time of N: PP = preplant; PF = preflood; PI = panicle initiation; PD = panicle differentiation.
 ** Means across and down columns; all means are significant at the 5% level.

** Means across and down columns followed by the same letter are not significantly different ($p < 0.05$) according to Duncan's multiple range test.

EFFECT OF STUBBLE MANAGEMENT AND N FERTILIZATION ON RATOON PERFORMANCE, GRAIN YIELD, AND YIELD COMPONENTS OF MERCURY RICE

P.K. Bollich, W.J. Leonards, Jr., S.M. Rawls, and D.M. Walker

INTRODUCTION

Ratoon cropping, or second cropping, has been practiced in Louisiana for many years. Second cropping gives the farmer an excellent opportunity to increase total production on a given area with a limited amount of additional input. At the present time, second crop production is rather inconsistent, and has not been fully exploited. Typically, a second crop gets little attention from the farmer, resulting in very low grain yields. Research has not adequately addressed second cropping systems. More emphasis is currently being placed on yield maximization of the second crop, by farmers as well as researchers.

Previous research has shown that cultural practices, varieties, and fertilization may influence second crop grain production. Varieties differ in their ratoon potential, and a variety with good ratooning ability may be influenced by management in both the main crop and the ratoon. Earlier research has shown some varieties to respond to higher rates of N. Stubble height also appears to influence second crop response, since clipping of the stubble and straw removal has increased tiller production and grain yield of some varieties. At the present time, a general recommendation for second crop production in Louisiana is to apply 45-60 lb N/A after main crop harvest and immediately flood the field.

This study was initiated to determine whether second crop grain yields could be improved by using better straw management techniques and a more defined nitrogen (N) fertilization program. The objectives of this study are to 1) determine the influence of three straw management techniques on tiller formation, grain yield, and yield components of the ratoon, 2) determine the influence of post-heading main crop N fertilization on tiller production and grain yield of the ratoon, and 3) determine optimum N rate for ratoon production.

MATERIALS AND METHODS

The medium grain, semidwarf variety Mercury was used in the study. A N rate of 120 lb/A as ammonium sulfate was banded approximately 2 inches deep with 60 lb/A P_2O_5 and K_2O 1 day prior to flooding the water-seeded experiment. Presoaked Mercury was seeded at the rate of 150 lb/A into a shallow flood. After 4 days the experiment was drained briefly to promote seedling anchorage. A permanent flood was established 3 days later. Pest control (weeds, insects, disease), when necessary, was practiced according to current recommendations. The experiment was harvested at field maturity, and main crop yield was estimated from eight individual whole plots.

The straw management systems were imposed onto the experiment after completion of harvest. Conventional straw management consisted of harvesting the main crop plots at a height of 14 to 16 inches (for optimum harvest

efficiency) and leaving the straw spread on the remaining stubble. A rolling treatment consisted of knocking down the stubble which had been handled in the conventional manner with a heavy roller. A clipping treatment consisted of recutting the stubble to a height of 6 to 8 inches after harvest and removing all straw.

Ten N treatments were imposed onto each of the three straw management systems. Two treatments consisted of applying either 30 or 60 lb N/A into the main crop floodwater (MCF) 4 days prior to harvest drainage, with no additional N applied in the second crop. Two treatments consisted of applying either 30 or 60 lb N/A into the MCF, followed by 45 lb N/A in the second crop. The remaining treatments included N rates of 0, 30, 45, 60, 75, and 90 lb/A applied only to the second crop. All second crop N treatments were applied to the stubble prior to establishing a shallow, permanent flood.

Number of tillers in the ratoon was determined 4 weeks after flooding. Individual whole plots were combine-harvested at field maturity. Days to 50% heading, grain moisture, and grain yield were measured. Total milled rice and % head rice were determined. Yield components and total biomass were measured.

SUMMARY AND CONCLUSIONS

A study was conducted to determine the influence of stubble management and N fertilization on performance, second crop grain yield, and yield components of Mercury rice. Main crop grain yield was estimated to be 8282 lb/A.

Clipping the rice stubble and removing the straw increased tiller production, total biomass, and grain yield. There was little difference between rolling and conventional straw management in their effects on these variables. Clipping also increased panicle number and weight, and grain weight.

Nitrogen rate appeared to exert more influence on grain yield and yield components than did N timing. Main crop heading applications of N had little influence on tiller production, grain yield, and most yield components unless additional N was applied to the second crop. Increasing N resulted in increases of all variables measured. Response of tiller production, whole plant weight, panicle number, and grain yield were similar when a minimum of 75 lb N/A was applied. A high rate of N applied in the MCF, followed by 45 lb/A in the second crop, resulted in grain yields similar to those measured when a single application of 75-90 lb N/A was applied to the second crop only. Total milled rice and percent head rice were not influenced by straw management or N application.

Experiment: Second crop improvement study

Location: Rice Research Station

Soil Type/Analysis: Crowley silt loam; ph: 5.7; O.M.: 0.90%; extractable nutrients (mg/kg): P-35, Na-79, K-86, Ca-770, Mg-165, Zn-1.10

Variety/Seeding Rate: MERC, 150 lb/A

Planting Method/Date: Water-seeded, Apr 8

Fertilization: 60 lb/A P_2O_5 and K_2O ppi, 120 lb/A N ppi (ammonium sulfate); second crop, variable rates of N

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: Apr 12

Water Management: Initial flood, Apr 7; drained, Apr 12; reflooded, Apr 15; drained, Apr 25; reflooded, Apr 28; drained, May 10; permanent flood, May 12; harvest drainage, July 21; second crop flooded, Aug 5; harvest drainage, Oct 2

Herbicides: 4 lb ai/A, Stam (propanil), Apr 27; 3 lb ai/A Stam + 0.75 lb ai/A Basagran (bentazon), May 11

Insecticides: 0.6 lb ai/A, Furadan (carbofuran), May 27

Fungicides: None

Harvest: Main crop, Aug 4; second crop, Oct 19

Experimental Design: Randomized complete block with four replications of 30 treatment combinations

Comments: A visual response to N was observed 3 weeks after emergence. Seedling vigor was good although cool temperatures prevailed during and after emergence. Main crop yield was estimated to be 8282 lb/A.

There appeared to be a slight visual response in tiller formation to N applied in the main crop prior to draining for harvest (Table 3). Tiller counts, however, revealed little difference between N applied in the MCF and N applied only to the stubble after harvest (Table 3). Days to 50% heading was not influenced by stubble management or N fertilization. Highest grain yields occurred when a minimum of 75 lb N/A were applied to the second crop (Table 2). A small increase in grain yield was observed due to clipping of the straw. Grain yields were somewhat higher with high rates of N combined with clipped or rolled stubble (Table 1).

Table 1. Influence of stubble management x N fertilization on tiller formation and grain yield of second crop Mercury rice. Rice Research Station, Crowley, LA. 1987.

Stubble management	N rate* (lb/A)	Tiller number (no/3 ft ²)	Grain yield at 12% moisture (lb/A)
Clipped	0h + 0r	347 ^{cdefghi}	1456 ^{ijklm}
	0h + 30r	414 ^{abcd}	1730 ^{defghij}
	0h + 45r	409 ^{abcde}	1787 ^{cdefgh}
	0h + 60r	452 ^{ab}	1982 ^{abcdefg}
	0h + 75r	430 ^{abc}	2174 ^{ab}
	0h + 90r	409 ^{abcde}	2116 ^{ab}
	30h + 0r	366 ^{bcdefg}	1668 ^{ghijkl}
	30h + 45r	449 ^{ab}	2019 ^{abcd}
	60h + 0r	395 ^{abcdef}	1788 ^{cdefgh}
	60h + 45r	468 ^a	2212 ^a
Conventional	0h + 0r	237 ^j	1380 ^{lm}
	0h + 30r	255 ^{hij}	1744 ^{defghi}
	0h + 45r	301 ^{fghij}	1752 ^{cdefghi}
	0h + 60r	245 ^{ij}	1698 ^{efghijk}
	0h + 75r	293 ^{fghij}	1889 ^{bcdefg}
	0h + 90r	288 ^{ghij}	2005 ^{abcdef}
	30h + 0r	304 ^{fghij}	1567 ^{hijklm}
	30h + 45r	272 ^{ghij}	1752 ^{cdefghi}
	60h + 0r	242 ^j	1567 ^{hijklm}
	60h + 45r	325 ^{defghij}	2007 ^{abcde}
Rolled	0h + 0r	334 ^{cdefghij}	1409 ^{klm}
	0h + 30r	247 ^{ij}	1428 ^{ijklm}
	0h + 45r	312 ^{efghij}	1500 ^{hijklm}
	0h + 60r	280 ^{ghij}	1746 ^{defghi}
	0h + 75r	339 ^{cdefghij}	1934 ^{abcdefg}
	0h + 90r	352 ^{bcdefghi}	1882 ^{bcdefg}
	30h + 0r	282 ^{ghij}	1355 ^m
	30h + 45r	363 ^{bcdefg}	1936 ^{abcdefg}
	60h + 0r	307 ^{fghij}	1689 ^{fghijk}
	60h + 45r	304 ^{fghij}	2066 ^{abc}
		18.05	10.46

* N rate: h = main crop heading application; r = second crop application.

Table 2. Influence of stubble management on tiller formation, grain yield, and yield components of second crop Mercury rice. Rice Research Station, Crowley, LA. 1987.

Stubble management	Tillers (no/3 ft ²)	Whole plant (g/3 ft ²)	Panicles (no/3 ft ²)	Panicle weight ----- (g/3 ft ²) -----	Grain weight ----- (g/3 ft ²) -----	Panicle weight -- (g/20 panicles) --	Grain weight -- (g/20 panicles) --	Sterile florets -- (no/20 panicles) --	Filled grains	Grain yield at 12% moisture (lb/A)
Clipped	414a	225b	127a	98a	85a	19a	17a	227a	703a	1893a
Conventional	276c	274a	99b	76c	65c	19a	17a	222a	735a	1736b
Rolled	312b	183c	104b	84b	71b	20a	18a	236a	758a	1694b
C.V. %	18.05	13.32	16.00	13.68	14.16	15.70	16.70	27.96	17.16	10.46

Table 3. Influence of nitrogen on tiller formation, grain yield, and yield components of second crop Mercury rice. Rice Research Station, Crowley, LA. 1987.

N rate* (lb/A)	Tillers (no/3 ft ²)	Whole plant (g/3 ft ²)	Panicles (no/3 ft ²)	Panicle weight ----- (g/3 ft ²) -----	Grain weight ----- (g/3 ft ²) -----	Panicle weight -- (g/20 panicles) --	Grain weight -- (g/20 panicles) --	Sterile florets -- (no/20 panicles) --	Filled grains	Grain yield at 12% moisture (lb/A)
0h + 0r	306b	185d	95c	64e	55e	16bc	15cd	158e	627bc	1440f
0h + 30r	306b	211c	96c	80cd	70cd	19b	17bc	211cde	730b	1663e
0h + 45r	341ab	220c	108abc	83c	72cd	19b	17c	263abc	740b	1709de
0h + 60r	325ab	217c	99bc	86c	74c	22a	20ab	266abc	846a	1840cd
0h + 75r	354ab	254ab	114ab	101a	86a	23a	20a	303a	873a	2028ab
0h + 90r	350ab	268a	117a	105a	89a	22a	20a	281ab	872a	2036ab
30h + 0r	317ab	207cd	109abc	72de	63de	17bc	15cd	165e	648bc	1556ef
30h + 45r	361ab	235bc	119a	89bc	77bc	18b	16cd	222cd	690bc	1935bc
60h + 0r	315ab	225c	121a	79cd	69cd	15c	14d	171de	590c	1711de
60h + 45r	366a	253ab	122a	98ab	84ab	19b	17c	244bc	707b	2132a
C.V. %	18.05	13.32	16.00	13.68	14.16	15.70	16.70	27.96	17.16	10.46

N rate: h = main crop heading application; r = second crop application.

DOUBLE CROPPING RICE FOLLOWING RICE AS AN ALTERNATIVE TO RATOON CROPPING

P.K. Bollich, W. J. Leonards, Jr., S.M. Rawls, and D.M. Walker

INTRODUCTION

In Louisiana, typical double-cropping systems have included wheat and soybeans, rice and crawfish, and to a lesser extent wheat and rice. Double-cropping systems offer the opportunity to produce more than one crop on the same land area annually. Various forms of reduced tillage seeding have been incorporated into double-cropped systems to take advantage of moisture and soil conservation, reduced labor and fuel costs, and earliness in getting the double crop initiated.

Rice producers in southwest Louisiana have been growing a ratoon crop, or second crop as it is commonly called, to increase total annual production per unit area for many years. With a minimum amount of input, a farmer may realize a second crop grain yield of 20-35% of the main crop. An important consideration for successful second cropping is the earliness in main crop planting. Early planting and early maturing varieties are necessary for successful second cropping, since the length of the growing season during the fall is relatively short. The time required to produce a second crop for most varieties is roughly 75% of that required for the main crop.

There has been no research to determine the feasibility in growing two planted rice crops within a season. Second cropping requires fewer days from main crop harvest to second crop harvest than would a crop planted from seed. Second cropping also offers the advantage of lower input for optimum yield. Yields of the second crop are much lower than main crop yields. Although yields are decreased somewhat in very late planted rice, a planted rice crop will generally outyield a second crop.

The objectives of this study are to 1) determine the feasibility of planting two successive rice crops from seed within a single growing season, 2) to compare a number of planting methods for the double crop, and 3) to compare two planted rice varieties in the double crop to the standard ratoon crop.

MATERIALS AND METHODS

The long-grain, semidwarf, California variety L202 was used in both planted crops. Tebonnet (TBNT), a tall, Arkansas, long-grain variety was used in the double crop only. A nitrogen rate of 120 lb/A as ammonium sulfate was banded approximately 2 inches deep with 60 lb/A P_2O_5 and K_2O 1 day prior to flooding the continuous flood, water-seeded experiment. Presoaked L202 was seeded at the rate of 150 lb/A into a shallow flood. Pest control (weeds, insects, disease) when necessary, was practiced according to current recommendations. The experiment was harvested at field maturity, and the first crop yield was estimated from eight individual whole plots.

A number of planting methods were imposed onto the experiment after completion of harvest. Conventional seedbed preparation consisted of tillage and smoothing to produce a fine, well-prepared seedbed. Rice stubble was either burned or left standing green. Presoaked TBNT and L202 were water-seeded into each seedbed type at a rate of 150 lb/A. A combine reseed treatment consisted of seed resulting from harvest loss in the first planted crop and was considered a replanted treatment. A ratoon was also produced from the L202 planted in the first crop. Rice straw had been removed from the reseed, ratoon, and stubble replant treatments. The experiment was drained after 3 days to allow for stand establishment. Eleven days after draining, the entire experiment received 60 lb N/A and was permanently flooded. Four weeks later all treatments except the ratoon of L202 were topdressed with an additional 30 lb N/A.

A small plot harvester was used to remove the center of each individual plot at field maturity. Grain moisture and grain yield were measured.

SUMMARY AND CONCLUSIONS

A field experiment was conducted at the Rice Research Station to determine the feasibility of double-cropping rice following rice within a single growing season. A number of planting methods and two rice varieties for the double crop were evaluated.

The first planting of L202 was fertilized with 120 lb N/A and resulted in a grain yield of 8168 lb/A. Highest grain yields in the second planting were observed when the seedbed was worked and prepared in the conventional manner (Table 1). Both L202 and TBNT produced significantly higher grain yields when planted in a conventional seedbed or when seeded into burned stubble. Burning the stubble opened the canopy of the first rice crop, which appeared to be desirable for seedling establishment. Burning also killed the ratoon, which eliminated the competition for nutrients and sunlight between the planted seed and the stubble regrowth. Tebonnet seeded into green stubble performed similar to seeding into burned stubble. Tebonnet is a taller variety and may not have been influenced by the first plant crop ratoon as significantly as was L202.

All treatments except the combine reseed produced significantly higher grain yields than the L202 ratoon. The reseed treatment was essentially an additional L202 ratoon. Although this treatment produced 249 lb grain/A more than the ratoon, this difference was not significant, and may have been a reflection of the topdress application of 30 lb N/A applied to the combine reseed treatment.

Cool temperatures in early October significantly decreased yield potential in the ratoon of L202 and in the reseeding treatments of L202 and TBNT. The highest grain yield of 3452 lb/A occurred when L202 was planted into a conventionally prepared seedbed, an increase of more than twice the yield of the L202 ratoon. The L202 ratoon received 60 lb N/A. Additional inputs required for the second planting were seedbed preparation, seed, and a topdress application of 30 lb N/A. Grain yield of L202 seeded into burned stubble was 1133 lb/A higher than the ratoon. Additional inputs required for this planting method were the burning operation and a topdress application of 30 lb N/A.

This preliminary study indicates that double-cropping rice following rice may be a profitable alternative to ratoon cropping. Further research is necessary to identify suitable varieties, and planting methods which reduce the time required for initiating the second planting.

Table 1. Grain yields of double-cropped L202 and Tebonnet (TBNT) long-grain rice varieties planted in conventional and non-conventional seedbeds. Rice Research Station, Crowley, LA. 1987.

Seedbed preparation	Variety	Grain yield at 12% moisture*
		----- (lb/A) -----
Conventional	L202	3452 ^a
Conventional	TBNT	3073 ^{ab}
Burned stubble	L202	2771 ^{bc}
Burned stubble	TBNT	2437 ^{cd}
Standing stubble	TBNT	2267 ^{cd}
Standing stubble	L202	2157 ^{de}
Combine reseed	L202	1887 ^{de}
Ratoon	L202	1638 ^e

* Means followed by the same letter are not significantly different ($P < 0.05$) according to Duncan's multiple range test.

Experiment: Rice double-cropping study

Location: Rice Research Station

Soil Type/Analysis: Crowley silt loam; ph: 5.7; O.M.: 0.90%; extractable nutrients (mg/kg): P-35, Na-79, K-86, Ca-770, Mg-165, Zn-1.10

Variety/Seeding Rate: L202, TBNT, 150 lb/A

Planting Method/Date: Water-seeded, Apr 3, July 31

Fertilization: First planting, 60 lb/A P_2O_5 and K_2O ppl, 120 lb/A N (ammonium sulfate); second planting, 90 lb/A² N (ammonium sulfate)

Plot Size: 7 x 25 ft (175 ft²)

Emergence Date: Apr 10, Aug 5

Water Management: Initial flood, Apr 3; drained, Apr 25; reflooded, Apr 28; drained, May 10; reflooded, May 12; harvest drainage, July 17; second planting flooded, July 31; drained, Aug 3; reflooded, Aug 14; harvest drainage, Nov 10

Herbicides: 4 lb ai/A, Stam (propanil), Apr 27; 3 lb ai/A Stam + 0.75 lb ai/A Basagran (bentazon), May 11

Insecticides: 0.6 lb ai/A, Furadan (carbofuran), May 27

Fungicides: None

Harvest: Main crop, July 28; double-crop, Nov 24

Experimental Design: Randomized complete block with four replications of eight treatment combinations.

Comments: A continuous flood system was used for the first planting. L202 displayed excellent seedling vigor and cold tolerance, and emerged through the water without draining for anchorage. Grain yield for the first planting was 8168 lb/A. In the second planting, stand establishment was very good when seedbeds were conventionally prepared. Seedling establishment was slower in the stubble plantings and reseed treatment. Early cold weather during panicle formation and flowering caused a high degree of sterility, which was reflected in the grain yields (Table 1).

NO-TILL AND STALE SEEDBED RICE PRODUCTION FOR LOUISIANA

P.K. Bollich, W.J. Leonards, Jr., S.M. Rawls, and D.M. Walker

INTRODUCTION

Rice farmers in Louisiana typically prepare a seedbed prior to planting in a number of ways. Rice land is usually worked in late fall or early spring to some extent. Operations may include disking, field cultivation, and water or dry leveling. Preparing a seedbed by some conventional means destroys weeds and provides moisture, nutrients, and air to allow for plant root penetration.

The advantages of conventional seedbed preparation are obvious. There has been considerable interest in recent years, however, to utilize no-tillage and stale seedbed planting practices in many crops. These techniques have been promoted to conserve moisture, reduce seedbed preparation costs, reduce soil erosion, and save time. Little attention has been given to adapting these tillage techniques to rice production.

A no-tillage system is the seeding of one crop into previous residue of another crop without disturbing the soil. A stale seedbed system requires early seedbed preparation, and then allowing a flush of weeds to develop prior to planting. In each of these systems, a herbicide treatment is used to control or kill existing vegetation at or before planting. The objective of this study is to determine the feasibility of producing rice using stale seedbed and no-tillage practices in the water and dry-seeded rice cultural systems.

MATERIALS AND METHODS

Stale seedbed and conventional treatments were disked twice and conditioned with a roller harrow 6 weeks prior to planting. The conventional treatments were vibra-shanked and conditioned at planting. Approximately 60 lb/A P_2O_5 and K_2O were banded with a conventional fertilizer drill 1 to 2 inches deep. In the water-seeded experiment, 115 lb N/A was also banded. In the dry-seeded experiment, the semidwarf, long-grain variety Lemont was seeded at the rate of 100 lb/A with a conventional drill. Both test areas were treated with an aerial application of Roundup. Four days after herbicide application, the water-seeded experiment was flooded and seeded with presoaked Lemont at 150 lb/A. The experiment was later topdressed with two 32 lb N/A applications. The drill-seeded experiment was flushed during the seedling stage. Prior to establishing the permanent flood, the drill-seeded experiment was fertilized with 115 lb N/A. Two topdress applications of 32 lb N/A were later applied. Pest control (weeds, insects, disease), when necessary, was practiced according to current recommendations. Individual whole plots were harvested at field maturity. Grain yield and moisture were determined.

SUMMARY AND CONCLUSIONS

The use of a conventional fertilizer and planting drill in this study revealed some limitations in fertilizer and seed placement. In the no-tillage treatment, much of the fertilizer remained at or near the soil surface. The

seedbed in this treatment was very hard and compacted. The double-disk openers of the conventional drill did a poor job of fertilizer placement. Seed placement in the no-tillage treatment of the drill-seeded study was nonuniform, with some seed remaining exposed after seeding. Shallow fertilizer placement contributed to some loss of preplant N and algal blooms in the water-seeded experiment. Poor seed placement caused nonuniformity in stand establishment. Some seed degradation by waterfowl was observed in each experiment. No difficulties were encountered with either fertilizer or seed placement in the stale seedbed treatment. The drill equipment worked as well in this situation as in the conventional seedbed. For consistent fertilizer and seed placement in no-tillage operations, and possibly very old stale seedbeds, equipment designed for reduced tillage will be necessary.

The burndown herbicide (Roundup) did an excellent job in controlling existing vegetation in the no-tillage and stale seedbed treatment. Weeds in the stale seedbed treatment included annual seedling grasses, dayflower, and some alligatorweed. Weeds in the no-tillage treatment consisted primarily of large winter annual broadleaves and alligatorweed. A lesser number of annual grasses and dayflower was present. Two postemergence herbicide applications were required in each experiment later during the season for control of dayflower and annual grasses in the drill-seeded experiment, and for control of duckweed in the water-seeded experiment.

Grain yields of each experiment were similar (Table 1). There were no differences in yield observed between the conventional and stale seedbed plantings in either the water-seeded or drill-seeded cultural system. Yields from no-tillage planting were significantly less, especially in the drill-seeded experiment where stand establishment problems were more severe.

This preliminary data shows the potential for utilizing stale seedbed techniques in Louisiana rice production. Although yields decreased in the no-tillage system, less input was required for production. The use of conventional equipment in this study may also have somewhat limited the potential of no-tillage planting.

Table 1. Influence of seedbed preparation on grain yield of Lemont rice. Rice Research Station, South Unit, Crowley, LA. 1987.

Cultural system	Seedbed preparation	Grain yield at 12% moisture*
		----- (lb/A) -----
Water-seeded	Conventional	6507 ^a
	Stale seedbed	6408 ^a
	No-tillage	5832 ^b
Drill-seeded	Conventional	6792 ^a
	Stale seedbed	6682 ^a
	No-tillage	5660 ^b

* Means followed by the same letter are not significantly different ($P < 0.05$) according to Duncan's multiple range test.

Experiment: Seedbed preparation alternatives

Location: Rice Research Station, South Unit

Soil Type/Analysis: Midland silty clay loam; ph: 5.5; O.M.: 1.20%;
extractable nutrients (mg/kg): P-67, Na-95, K-99,
Ca-1633, Mg-438, Zn-2.26

Variety/Seeding Rate: LMNT, 100 lb/A

Planting Method/Date: Drill-seeded, May 22

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; 115 lb/A N (ammonium sulfate) pf,
June 23; 32 lb/A N^2 topdress, July 17, July 27

Plot Size: 35 x 85 ft (2975 ft²)

Emergence Date: May 29

Water Management: Flushed, May 27; flushed, June 7; permanent flood, June 24;
harvest drainage, Sep 7

Herbicides: 1 lb ai/A, Roundup (glyphosate), May 23; 4 lb ai/A Stam
(propanil) + 1 lb ai/A Basagran (bentazon), June 5; 3 lb ai/A
Stam + 0.5 lb ai/A Basagran, June 23

Insecticides: 0.6 lb ai/A, Furadan (carbofuran), July 17

Fungicides: 0.5 lb ai/A Rovral (iprodione), July 28; 0.5 lb ai/A Benlate
(benomyl), Aug 13

Harvest: Sep 24

Experimental Design: Completely randomized, 12 replications

Comments: Nonuniform stand establishment occurred in no-tillage plots.

Exposed seed was subject to bird depredation, with some loss of stand in small areas. Roundup application gave good control of existing vegetation. Two additional herbicide applications were required to control a heavy infestation of dayflower and annual grasses prior to permanent flood establishment. Nitrogen deficiency occurred prior to panicle differentiation, and two N topdressing applications were necessary to correct the deficiency. Sheath blight was moderate, and did not appear until late in the season. The fungicide treatments gave adequate control. Grain yield was significantly decreased in the no-tillage treatment (Table 1).

Experiment: Seedbed preparation alternatives

Location: Rice Research Station, South Unit

Soil Type/Analysis: Crowley silt loam; ph: 5.8; O.M.: 1.25%; extractable nutrients (mg/kg): P-63, Na-73, K-83, Ca-1443, Mg-296, Zn-1.57

Variety/Seeding Rate: LMNT, 150 lb/A

Planting Method/Date: Water-seeded, May 27

Fertilization: 60 lb/A P_2O_5 and K_2O ppi; 115 lb/A N (ammonium sulfate) ppi, May 22; 32 lb/A N topdress, July 17, July 27

Plot Size: 35 x 85 ft (2975 ft²)

Emergence Date: June 1

Water Management: Initial flood, May 27; drained, May 29; flooded, June 2; drained, June 4; flooded, June 7; drained, June 16; permanent flood, June 24; harvest drainage, Sep 7

Herbicides: 1 lb ai/A, Roundup (glyphosate), May 23; 4 lb ai/A Stam (propanil), June 5; 3 lb ai/A Stam + 0.5 lb ai/A Basagran (bentazon), June 23

Insecticides: 0.6 lb ai/A, Furadan (carbofuran), July 17

Fungicides: 0.5 lb ai/A Rovral (iprodione), July 28; 0.5 lb ai/A Benlate (benomyl), Aug 13

Harvest: Sep 24

Experimental Design: Completely randomized, 12 replications

Comments: Poor fertilization placement caused algal bloom formation, requiring draining and reflooding. Loss of N occurred due to shallow placement, and draining and reflooding procedures. Poor stand establishment occurred in some areas, due primarily to seed drift and bird degradation, especially in the no-tillage treatments. Roundup application gave good control of existing vegetation. Two additional herbicide applications were required to control a heavy infestation of dayflower, annual grasses, and duckweed. Loss of N early during the season necessitated two N topdressing applications for correction of N deficiency. Sheath blight was moderate, and did not appear until late in the season. The fungicide treatments gave adequate control. Grain yield was significantly decreased in the no-tillage treatment (Table 1).

FOUNDATION SEED RICE PROGRAM

Lawrence M. White, III

INTRODUCTION

Foundation seed rice has been produced by the Rice Research Station for distribution to Louisiana farmers since 1949. The station's seed rice program was instituted in response to the critical shortage of pure planting stocks which existed during and after World War II. Since its inception, the program has made available to Louisiana growers over 95,000 cwt. of pedigreed stock of 21 rice varieties.

Concurrent with the distribution of pure seed by the Rice Research Station, there developed in Louisiana an industry comprised of independent seed dealers through whom farmers could conduct trade in registered and certified classes of pedigreed rice.

Foundation seed rice, the planting stock from which registered and certified seed are produced, is the farmers link with the work of the plant breeder. It is the product of hybridization and of successive generations of selection and testing to establish its value as crop seed and eventually as a commercial commodity. For this reason, foundation seed and the basic stocks from which it is produced, must be grown and conditioned in a manner which will insure that viability is maintained and that it be genetically pure and free from mechanical mixtures or contamination by noxious weeds.

Through the Rice Research Station's seed program, Louisiana farmers may obtain seed rice of improved varieties developed through the Louisiana Agricultural Experiment Station breeding program and of established commercial varieties originating either at Crowley or at research centers in neighboring states.

In order to fulfill the objectives of the seed program, the Rice Research Station utilizes the personnel, land, machinery, and other facilities needed to plant, harvest, condition, and store its annual seed rice crop. The production of breeder seed, planting stock for the foundation fields, and the maintenance of purity in commercial rice varieties are functions of the seed program. Breeder seed is sometimes grown within fields of foundation rice, or in a special nursery, set aside for propagating the Rice Research Station's seed stocks. The nursery also serves as a site for evaluating, purifying, and increasing selections from the Louisiana Agricultural Experiment Station breeding program which show promise as new varieties.

The distribution of pedigreed seed rice produced by the Rice Research Station is done according to a formula adopted by the Louisiana Seed Rice Growers Association. For each rice producing parish, the amount of seed allotted to an individual parish is determined by the percentage of the states total rice acreage grown in that parish during the previous crop year.

Personnel of the LSU Extension Service in cooperation with parish committees of the Seed Rice Growers Association assist in the allocation of foundation seed rice. It is at the parish committee level that the allocation of seed to individual growers is decided. The county agents receive applications for seed rice from growers and handle information and publicity for the pure seed program.

In this state, the official seed certifying agency for all crops is the Louisiana Department of Agriculture. The rules and regulations pertaining to the certification of agricultural seeds are part of the Louisiana Seed Law. They are formulated by the Louisiana Seed Commission and enforced by the Agronomic Programs Division of the Louisiana Department of Agriculture. Personnel of the Agronomic Programs Division, operating from district offices conduct field inspections of growing rice and sampling of bagged rice for laboratory analyses which consist of purity determinations and germination tests.

PRODUCTION PRACTICES

Each year, the Rice Research Station devotes approximately 80 acres of land to the production of foundation seed rice. In order to eliminate noxious weeds, especially red rice, which can disqualify rice from certification, the fields are fallowed for a 2-year period preceding planting. This also enables the fields to meet the crop history requirements specified in the seed rice regulations.

Following seedbed preparation, foundation fields are planted by means of a 16-runner grain drill which is equipped for separate placement of seed and fertilizer. A basal application of fertilizer (60-60-60 lb/A of NPK) is made at the time of seeding. The breeder stock is planted at the rate of approximately 100 lb/A. The rice receives a preflood application of ammonium sulfate in which the rate of N may vary from 30 to 90 lb/A.

Seedling grasses and weeds are controlled by means of commercially available herbicides, applied by airplane. Similarly, aerial applications of insecticides are used to protect the fields from outbreaks of harmful insects.

Roguing of the rice fields for the removal of off-types, varietal mixtures, and noxious weeds, begins at the onset of heading and continues until the rice is harvested. During this interval, the headed rice is inspected by personnel of the Agronomic Programs Division to determine whether or not it meets minimum field standards of the certifying agency.

The rice is harvested with a conventional combine, and dried in the Rice Research Station's continuous flow drier to a moisture level of approximately 12%. During the storage period between drying and cleaning, the rice is treated with an insecticide in order to protect it from stored-grain insects.

Cleaning of foundation and breeder seed usually commences in late October and continues until late December. The rice first moves through an air-and-screen cleaner which removes chaff, straw, and other foreign material and grades the grain according to width and thickness.

It then flows through two sets of length grading machines which consist of rotating, indented metal cylinders. The first set of cylinders removes stemmy rice, grains which have very long awns or which are attached to portions of the panicle. The second set removes small grains and broken or dehulled kernels of rice.

In the final phase of cleaning, the rice moves through a machine which performs diameter grading of the grain by means of rapidly oscillating perforated screens. This machine is designed to separate medium-grain and/or red rice from long-grain rice. It is also capable of removing shrivelled and other slender kernels from medium-grain rice.

From the cleaning machines, foundation and breeder seed rice flow directly into a treater which applies a measured quantity of liquid fungicide for protection of young rice plants from seedling disease. The rice is bagged as it comes from the treater, assigned a lot number, and placed in storage in the Station's seed rice warehouse where it remains until the time that it is distributed to Louisiana farmers.

The field and laboratory purity standards for foundation seed rice are very strict with regard to varietal mixtures and noxious weeds. In all phases of production, therefore, great care must be exercised in order to prevent these impurities from contaminating the seed stocks. To that end, it is routine procedure at the Rice Research Station to partially disassemble all planting and harvesting equipment and to clean it thoroughly with water and/or compressed air before using it in the field. The drier and cleaning plant, including all elevators and other conveying equipment, are also subjected to meticulous cleaning and inspection before and after each variety of rice is handled. The machineries used in fallow plowing and in seedbed preparation are important sources of contamination after having been used in stubble fields. Therefore, tractors, plows, harrows, and land levelers are carefully washed before they enter land which is in a fallow cycle. These measures, together with the inspection and rouging which are done during the growing season, help to insure that foundation seed is genetically pure and free of mechanical mixtures and noxious weed seeds.

1987 Activities

Of the 3825 cwt. of foundation seed available for sale in March 1987, 2250 cwt. sold as foundation. The varieties and quantities were as follows: Lemont, 900 cwt.; Mars, 680 cwt.; Tebonnet, 500 cwt.; and Mercury, 170 cwt. An additional 360 cwt. of Lemont; 140 cwt. of Mars; and 1075 cwt. of Tebonnet were downgraded to certified class and sold on bids.

The Rice Research Station's foundation seed crop in 1987 consisted of 23.27 acres of Mercury, 17.08 acres of Lemont, and 12.25 acres of Tebonnet.

Breeder seed was grown in 1987 as follows: Mercury, 1.00 acre; Gulfmont, .70 acre; Tebonnet, .40 acre; Lemont, .40 acre; and Toro-2, .10 acre.

Headrows of Mercury and 2186, an experimental aromatic long-grain variety, were also grown in 1987.

RICE FIELD PEST MANAGEMENT

EFFECT OF THREE PLANTING DATES ON BLACKBIRD DAMAGE TO SPROUTING RICE^{1/}

E.A. Wilson, K.M. Weaver^{2/}, and E.A. LeBoeuf^{2/}

INTRODUCTION

Sprouting rice suffers locally serious losses from blackbird (Icteridae) depredations, and monetary loss to an individual farmer can be substantial. Cultural control of bird depredation is potentially the most cost-effective form of preventing damage to newly-planted rice. Based on changes in blackbird population structure and feeding patterns, delayed planting has long been recommended as a way of reducing blackbird damage to sprouting rice. However, variation in the degree of bird-caused damage to sprouting rice associated with different planting dates has only recently been documented (Wilson et al., 1986). This study was conducted to provide additional information relative to the effect of planting date on blackbird damage to sprouting rice.

MATERIALS AND METHODS

Four experimental units (EU) were established in areas of traditionally high blackbird use. Two EU's were located in close proximity to the coastal marsh of Vermilion Parish, Louisiana. Two EU's were located near the Miller's Lake blackbird roost in Evangeline Parish, Louisiana. Each EU consisted of three 6- to 9-acre fields, with each field located less than 0.25 miles from the other two. Within EU's, fields were randomly selected to be planted either early-season (March 15), mid-season (April 1), or late-season (April 15). Cooperating growers were asked to plant the fields as close as possible to the target dates.^{3/}

Fields were aerially seeded with 135 lb of seed per acre. Rice was grown using normal cultural practices, as determined by the cooperating grower. Growers were instructed to take no measures to protect fields from depredating birds.

To determine sprout loss, 50 paired sample points, each consisting of two 2-ft² plots, were established within each field. Within each pair, one plot was protected from bird damage with a wire screen enclosure, and the other plot was unprotected. Each field was divided into two strata of equal width. Five transects were randomly located within each stratum. Paired sample points were systematically placed along these transects as described by Otis et al. (1983). Protected plots were located on the transect; unprotected plots were placed 6

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^{2/} Wildlife Biologists, U.S. Department of Agriculture/APHIS/Animal Damage Control.

^{3/} Appreciation is expressed to farmers Steven Plaisance, Ludring Plaisance, Steve Benson, and Mitch Benson for their cooperation in this experiment.

feet away on a randomly selected bearing from the transect. Exclosures, which were determined not to affect the distribution of aerially-seeded rice, were placed in each field immediately before or after seeding. Seedlings were counted in all protected and unprotected plots when rice reached a height of approximately 3 inches and was beyond the stage of vulnerability to bird damage. Appropriate formulas were applied to these counts to determine estimates of total and percent sprout loss on each field.

To determine the relative bird use of early-, mid-, and late-season fields, bird counts were made on each field during the bird-vulnerable period. Each count consisted of a 30-minute census conducted from the field edge between sunrise and 1000 hours. During each census, birds were recorded by number and species for each minute of observation.

RESULTS AND DISCUSSION

Estimates of total sprout loss were significantly different among planting periods (RCB ANOVA; $P < 0.05$); total sprout loss estimates were about five times greater for early- and mid-season fields than for late-season fields. Estimates of percent sprout loss averaged 14.7 for late-season fields, compared to 99.7 for early-season fields and 84.8 for mid-season fields (Table 1).

Blackbird use of fields planted early-season was extremely high and averaged 822 birds per minute of observation (Table 2). Bird use of mid-season fields appeared lower than that for early-season fields (average 266 birds/minute), but sprouting-rice damage was similar for the two planting periods (Duncan's multiple range test; $P > 0.05$). Late-season bird use of fields declined to an average of 30 birds per minute. Mean sprout loss for late-season fields was significantly less than that for early- and mid-season fields (Duncan's multiple range test; $P < 0.05$) (Tables 1 and 2).

Red-winged Blackbirds (Agelaius phoeniceus) were responsible for almost all rice depredations; redwings made up over 95% of all target birds observed on test fields. Boat-tailed Grackles (Quiscalus major) were serious depredators in one early-season field. Great-tailed Grackles (Quiscalus mexicanus) were observed in insignificant numbers.

The reduction of bird damage in late-season fields can be attributed to a combination of factors affecting blackbird numbers and feeding behavior. The departure of northern migrants, a decline in the number of roosting birds, the dispersal of birds over nesting territories, a shift in dietary preference from grain to insects, and increased food availability are factors which may be responsible for the decreased bird use of late planted fields.

Although late-season planting shows great promise for reducing bird-caused damage to sprouting rice, the success of this technique is likely to vary by year and location. Grubb (1987) noted that avian feeding and flocking behavior may vary with time, weather, and food availability. In this study, late-season planting resulted in somewhat greater sprouting-rice damage than that observed by Wilson et al. (1986). However, both studies substantiate the benefits of late-season planting for reducing blackbird depredation on sprouting rice.

Table 1. Blackbird damage to sprouting rice in fields planted early-season (March 13-16), mid-season (March 31-April 2), and late-season (April 16), Vermilion and Evangeline Parishes, Louisiana. 1987.

Experimental unit	Planting period	Expected number of sprouts	Estimated no. of sprouts lost	Percent sprout loss
1	Early season	3,687,000	3,687,000	100.0
2	"	5,190,000	5,165,000	99.5
3	"	5,619,000	5,619,000	100.0
4	"	5,016,000	4,988,000	99.4
			$\bar{x} = 4,864,750$	$\bar{x} = 99.7$
1	Mid-season	6,991,000	6,971,000	99.7
2	"	5,519,000	3,037,000	55.0
3	"	4,467,000	4,228,000	94.6
4	"	4,794,000	4,310,000	89.9
			$\bar{x} = 4,636,500$	$\bar{x} = 84.8$
1	Late-season	6,901,000	2,019,000	29.3
2	"	9,095,000	639,000	7.0
3	"	4,487,000	849,000	18.9
4	"	8,739,000	317,000	3.6
			$\bar{x} = 956,000$	$\bar{x} = 14.7$

Table 2. Blackbird use of rice fields planted early-season (March 13-16), mid-season (March 31-April 2), and late-season (April 16), Vermilion and Evangeline Parishes, Louisiana. 1987.

Experimental unit	Planting period	Number of observation periods	Birds per minute of observation	Range (daily means)
1	Early-season	5	1643	116-4731
2	"	5	620	178-1232
3	"	5	442	202- 603
4	"	5	584	279- 817
			$\bar{x} = 822$	
1	Mid-season	4	310	248- 377
2	"	4	89	40- 175
3	"	6	328	41-1248
4	"	5	338	75- 780
			$\bar{x} = 266$	
1	Late-season	7	41	4- 125
2	"	7	18	9- 49
3	"	7	23	5- 61
4	"	8	38	5- 71
			$\bar{x} = 30$	

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PLANT PHYSIOLOGY

INTRODUCTION

Plant growth regulators (PGRs) can have a tremendous effect on crop production because of their ability to alter plant growth and development. Therefore, studies of PGR modifications to plant growth and development which would improve rice production were conducted.

At present, PGRs have been identified which can modify internode elongation and research has shown modification of internode elongation can be beneficial. To date, research has shown PGRs can reduce plant stature by limiting internode elongation. In varieties susceptible to lodging because of tall stature, reductions in plant height by PGRs have been accomplished and have resulted in a greater tolerance of tall varieties to lodging. In addition, studies to modify internode elongation in rice have shown that PGRs can limit exsertion of the panicle. Studies of this particular response to properly timed applications of PGRs have shown that seed production in red rice can be prevented. In that respect PGRs offer the first control measures for established red rice in commercial rice production. Studies on preventing red rice seed production were continued.

Recently in preliminary greenhouse trials, emergence has been improved with PGR seed treatments which cause mesocotyl and coleoptile elongation. These structures are short in some semidwarf cultivars and seeding more than 1 inch below the soil surface can result in poor stands. These studies were moved into the field in 1987. In addition seedling height of semidwarf rice increases slowly resulting in poor seedling vigor, and studies to increase seedling height with PGRs were initiated in 1987.

Another area of interest relating to PGRs involves rice biomass production for forage for crawfish. Along with nitrogen fertility, PGRs that promote vegetative growth and elongation are being studied to determine their effects on biomass production and persistence under a winter flood. These studies were continued in 1987.

To address the objectives of stature reduction, red rice seed elimination, emergence and seedling vigor improvement of semidwarf cultivars and biomass enhancement for crawfish production, PGRs were tested for their effects on rice growth and development.

PLANT GROWTH REGULATOR RESEARCH IN RICE

R. Dunand, R. Dilly, Jr., and G. Meche

Experiment: Stature Reduction in Rice with Mefluidide

Location: Rice Research Station, North Unit

Soil Type/Test Results: Crowley silt loam/none

Variety/Seeding Rate: Tebonnet/100 lb/A

Planting Date: 27 Apr 87

Row Spacing: 7 in

Fertilizer: 21-63-63-3.6 (N-P₂O₅-K₂O-ZnSO₄) as 7-21-21-1.2 Zn on 27 Apr and 100-0-0 as urea (46%) on 1 June and 42-0-0 as ammonium sulfate (21%) on 2 and 7 July

Plot Size: 8.75 x 30 ft

Treated Area: 8.75 x 30 ft

Treatments:

Application times: 16 June (Tebonnet at late tiller)
23 June (Tebonnet at panicle initiation)
10 July (Tebonnet at mid boot)

Application rates: 0.03 and 0.06 lb/A at late tiller
0.06 and 0.12 lb/A at panicle initiation
0.125 and 0.25 lb/A at mid boot

Sprayer: CO₂-driven, hand-held, 32 psi, 15 GPA, 80015 nozzles

Pertinent Rainfall:

Herbicide(s): 3 lb/A propanil (Stampede) on 20 May and 3 June

Insecticide(s): 0.5 lb/A carbofuran (Furadan) on 16 June

Fungicide(s): 0.17 lb/A propriconazole (Tilt) on 2 and 17 July

Emergence: 12 May

Water Management: Flushed on 1 May and 21 May; Permanent flood on 4 June;
Drained on 7 Aug

Harvest Date: 19 Aug

Harvested Plot Area: 8.75 x 30 ft

Experimental Design: Randomized complete block (4 replications), factorial treatment arrangement

Comments: Reduction in lodging of Tebonnet through stature reduction with mefluidide was studied. Time and rate of mefluidide were varied during the vegetative and reproductive phases of growth. No lodging occurred, and lodging was not evaluated. The effects of mefluidide on plant height and grain production are presented in Table 1.

As opposed to mefluidide applied at late tiller and panicle initiation, mefluidide applied at mid boot lowered plant height, grain moisture and grain yield. Plant height for the untreated check and the late tiller and panicle initiation timings was 60 inches. In comparison, plant heights for the mid boot timing were 58 and 56 inches with 0.12 and 0.25 lb/A, respectively. Plant height at the low rate was significantly lower than the untreated check and late tiller and panicle initiation timings, and plant height at the high rate was significantly lower than plant height at the low rate. Similar trends were noted for grain moisture and yield. Grain moisture for the untreated check and late tiller and panicle initiation timings ranged between 21.6 and 22.4% and were not significantly different. Grain moistures for the mid boot timing high and low mefluidide rates were 20.2 and 20.3%, respectively. Grain moistures for the high and low rates were not significantly different, but each was significantly different from grain moistures of the other mefluidide treatments and the untreated check. Grain yields for the untreated check and later tiller and panicle initiation timings ranged between 6860 and 7360 lb/A and were not significantly different. Grain yields for the mid boot timing high and low mefluidide rates were 6680 and 4830 lb/A, respectively. Grain yield for the mid boot low mefluidide rate was significantly lower than grain yield of the panicle initiation timing/0.12 lb/A rate and was not significantly different from the other late tiller and panicle initiation treatments or the untreated check. Grain yield for the mid boot high mefluidide rate was significantly lower than grain yield for the mid boot low mefluidide rate.

Mefluidide can reduce plant stature when applied during late stem development. This may add lodging tolerance to tall rice cultivars, but the reduction in grain yield associated with mefluidide induced reduction in plant stature is unacceptable.

Table 1. Effect of mefluidide on plant height and grain production of Tebonnet. Rice Research Station, Crowley, LA. 1987.

Application		Plant height (in)	Grain	
Time (GS ¹)	Rate (lb/A)		Moisture (%)	Yield (lb/A)
	0	60a ²	21.8a	6980ab
LT	0.03	60a	21.9a	6860ab
	0.06	60a	22.4a	7130ab
PI	0.06	60a	21.6a	7170ab
	0.12	60a	21.7a	7360a
MB	0.12	58b	20.2b	6680b
	0.25	56c	20.3b	4830c

¹ Growth stage; LT = late tiller, PI = panicle initiation, MB = mid boot.

² Differences within columns determined by the Duncan's multiple range test.

PLANT GROWTH REGULATOR RESEARCH IN RICE

R. Dunand, R. Dilly, Jr., and G. Meche

Experiment: Stature Reduction in Rice with XE-1019

Location: Rice Research Station, North Unit

Soil Type/Test Results: Crowley silt loam/none

Variety/Seeding Rate: Tebonnet/(see Treatments)

Planting Date: 27 Apr 87

Row Spacing: 7 in

Fertilizer: 21-63-63-3.6 (N-P₂O₅-K₂O-ZnSO₄) as 7-21-21-1.2 Zn on
27 Apr/for topdress see treatments

Plot Size: 4.75 x 25 ft

Treated Area: 4.75 x 15 ft

Treatments:

Application time: 9 June (Tebonnet at late tiller)

Application rate: 0.02 lb/A

Seeding rates: 100 and 150 lb/A

Topdress nitrogen rates: 100 and 160 lb/A as urea (46%) on 1 June and 42-0-0
(ammonium sulfate) on 2 & 7 July

Sprayer: CO₂-driven, hand-held, 32 psi, 15 GPA, 80015 nozzles

Pertinent Rainfall: Rained 9 consecutive days following application for a
total of 5.25 in

Herbicide(s): 3 lb/A propanil (Stampede) on 20 May and 3 June

Insecticide(s): 0.5 lb/A carbofuran (Furadan) on 16 June

Fungicide(s): 0.17 lb/A propriconazole (Tilt) on 2 & 17 July

Emergence: 12 May

Water Management: Flushed on 1 May and 21 May; Permanent flood on 4 June;
Drained 7 Aug

Harvest Date: 20 Aug

Harvested Plot Area: 2.33 x 15 ft

Experimental Design: Randomized complete block (8 replications), factorial
treatment arrangement

Comments: XE-1019 was studied to determine its ability to prevent lodging in rice. The results are presented in Table 1.

XE-1019 reduced plant height and the effect was dependent on nitrogen fertility. At 100 lb N/A there was no significant effect on plant height and at 150 lb N/A XE-1019 reduced plant height significantly. Other factors affected were grain moisture and yield. With the 100 lb/A seeding rate, XE-1019 decreased grain moisture. In general, grain yield was increased by the higher nitrogen rate and decreased by XE-1019. No lodging occurred and an evaluation of XE-1019 as a lodging preventive was precluded.

Table 1. The effect of XE-1019 on plant stature and grain production of Tebonnet rice varying seeding rate and nitrogen fertility. Rice Research Station, Crowley, LA. 1987.

Seeding rate (lb/A)	Nitrogen rate (lb/A)	XE-1019 rate (lb/A)	Plant height (in)	Grain	
				Moisture (%)	Yield (lb/A)
A. Main effects					
100			45b ¹	21.4	7070
150			44a	20.8	7230
	100		43	20.7b	6690b
	150		46	21.6a	7600a
		0	45	21.6	7340a
		0.2	43	20.7	6960b
B. Interactive effects					
100		0	46	22.2b	7210
		0.2	44	20.6a	6920
150		0	45	20.9a	7460
		0.2	43	20.8a	7000
	100	0	43bc	21.2	6840
		0.2	42c	20.2	6550
	150	0	47a	21.9	7830
		0.2	44b	21.2	7380

¹ Differences within columns determined by the Duncan's multiple range test (P<.05).

PLANT GROWTH REGULATOR RESEARCH IN RICE

R. Dunand, R. Dilly, Jr., and G. Meche

Experiment: Mefluidide and Red Rice Seedhead Suppression - Time and Rate of Application Study

Location: Rice Research Station, South Unit

Soil Type/Test Results: Crowley silt loam/none

Variety/Seeding Rate: Tebonnet/200 lb/A

Planting Date: 16 Apr 87

Row Spacing: Broadcast (water-seeded)

Fertilizer: 21-63-63-3.6 (N-P₂O₅-K₂O-ZnSO₄) as 7-21-21-1.2 Zn and 90-0-0 as urea (46%) preplant incorporated on 13 Apr

Plot Size: 5 x 30 ft

Treated Area: 5 x 30 ft

Treatments:

Application times: 19 June (Tebonnet at mid boot)
22 June (Tebonnet at first heading)
29 June (Tebonnet at 100% heading)
7 July (Tebonnet at milk stage)

Application rates: 0, 0.125, 0.25 and 0.5 lb ai/A

Sprayer: CO₂-driven, hand-held, 32 psi, 15 GPA, 80015 nozzles

Pertinent Rainfall: 0.5 in. 3 hr. after application on 29 June
0.7 in. 3 hr. after application on 8 July

Herbicide(s): None

Insecticide(s): 0.5 lb/A carbofuran (Furadan) on 14 May

Fungicide(s): 0.17 lb/A propriconazole (Tilt) on 23 June

Emergence: 19 Apr

Permanent Flood: 22 Apr

Drained: 17 July

Harvest Date: 30 July

Harvested Plot Area: 4 x 27 ft
center 4 x 25 ft

Experimental Design: Randomized complete block (4 replications), factorial treatment arrangement

Comments: Mefluidide was applied to Tebonnet rice infested with red rice. Red rice reproductive development was suppressed, and grain red rice content, milling yield, and grain yield were decreased. The results are presented in Tables 1 and 2.

The effects of time and rate of mefluidide application on red rice are presented in Table 1. Red rice stem development, partially panicle exertion and partially exerted panicle length, were not affected by mefluidide. Red rice panicle suppression as measured by number of stems bearing no panicle was highest for the early (EB) and late boot (LB) timings, intermediate for the fully headed (FH) timing, and lowest with the milk stage (MS) timing. Barren stems numbered 6, 7, 4, and 1 stem/10 plants for the EB, LB, FH, and MS timings, respectively. Barren stems for the EB and LB timings were significantly higher than for the MS timing. Stems unaffected by mefluidide application are presented although the data is highly variable. The most consistent results were with the EB and LB timings. With the EB timing, there were significantly fewer fully exerted red rice panicles with the 0.25 and 0.5 lb/A mefluidide rates. With the LB timing, there were significantly fewer fully exerted panicles with the 0.5 lb/A mefluidide rate only.

The effects of mefluidide on grain production are presented in Table 2. Grain red rice content was decreased by mefluidide, and this was reflected in the rough and brown rice. Rough rice red rice contents were 0.44, 0.4, 0.14, and 0.21% with 0, 0.125, 0.25, and 0.5 lb/A mefluidide, respectively. Brown rice red rice contents were 0.22, 0.13, 0.06, and 0.05%. Total and whole milling yields were evaluated, and whole milling yield had the most consistent results. With the EB timing, whole milling yield was decreased by the 0.5 lb/A rate only. With the LB timing, all mefluidide rates decreased whole milling yield, and with the FH and MS timings, the 0.25 and 0.5 lb/A mefluidide rates decreased whole milling yield. In addition, grain yield was lowered by time and rate of mefluidide application. Grain yields with the LB, FH, and MS timings were significantly higher than grain yield with the EB timing, averaging 6200, 6000, and 5900 lb/A compared to 5400 lb/A, respectively. Grains yields were 6410, 6190, 5730, and 5170 lb/A with the 0, 0.125, 0.25, and 0.5 lb/A rates of mefluidide, respectively. Grain yield was lowered significantly with the 0.25 lb/A rate, and grain yield with the 0.5 lb/A rate was significantly lower than grain yield with the 0.25 lb/A rate.

The results indicate mefluidide can reduce panicle exertion in red rice and, consequently, red rice seed in harvested grain. Some possible side effects may be lower milling yields and grain yields.

Table 1. The effect of mefluidide on stem formation and panicle exertion of red rice. Rice Research Station, Crowley, LA. 1987.

Application		Stem production (stems/ 10 plants)	Panicle suppression (barren stems/ 10 plants)	Panicle exertion		Partially exserted panicle length (in)
Time (GS ¹)	Rate (lb/A)			Full (panicles/ 10 plants)	Partial (panicles/ 10 plants)	
A. Main effects						
EB		32	6a ²	13	13	3
LB		29	7a	13	9	3
FH		32	4ab	17	10	3
MS		27	1b	10	16	3
	0	30	2c	16	13	3
	0.125	29	2c	16	12	3
	0.25	30	6b	13	11	3
	0.5	31	10a	9	13	3
B. Interactive effects						
EB	0	34	2	17bcd	15	3
	0.125	34	1	22a	11	3
	0.25	26	9	6fg	11	3
	0.5	33	14	5g	14	3
LB	0	31	4	16b-e	12	2
	0.125	26	4	14de	7	2
	0.25	32	6	15cde	11	3
	0.5	28	16	5g	6	2
FH	0	30	2	15cde	13	4
	0.125	29	1	17bcd	11	3
	0.25	30	5	19ab	6	2
	0.5	37	8	18bc	11	3
MS	0	27	1	15cde	11	2
	0.125	26	>1	9f	18	3
	0.25	30	2	13e	16	3
	0.5	27	2	6fg	19	3

¹ Tebonnet growth stage; EB = early boot, LB = late boot, FH = fully headed, MS = milk stage.

² Differences within columns determined by the Duncan's multiple range test (P<.05).

Table 2. The effect of mefluidide on grain red rice content, milling yield and grain moisture and yield. Rice Research Station, Crowley, LA. 1987.

Application		Red rice content		Milling yield		Grain	
Time (GS ¹)	Rate (lb/A)	Rough rice (%)	Brown rice (%)	Total (%)	Whole (%)	Moisture (%)	Yield (lb/A)
A. Main effects							
EB		0.34	0.15	71.7b	64.0	21.6a	5400b
LB		0.24	0.11	72.0ab	65.1	20.5b	6200a
FH		0.30	0.11	71.7b	60.1	21.7a	6000a
MS		0.30	0.14	72.3a	60.7	21.5a	5900a
	0	0.44a ²	0.22a	71.8	66.1	21.5	6410a
	0.125	0.40a	0.18a	71.9	62.5	21.0	6190a
	0.25	0.14b	0.06b	72.1	61.1	21.4	5730b
	0.5	0.21ab	0.05b	71.8	60.2	21.4	5170c
B. Interactive effects							
EB	0	0.51	0.20	71.7	65.0bc	22.4	6010
	0.125	0.58	0.26	71.8	65.1bc	20.5	6030
	0.25	0.15	0.07	71.9	63.2bcd	21.2	5450
	0.5	0.16	0.08	71.5	62.8cde	22.4	4120
LB	0	0.22	0.14	72.0	69.1a	20.7	6610
	0.125	0.44	0.19	71.4	63.5bcd	20.4	6600
	0.25	0.22	0.10	72.2	64.6bc	20.7	6050
	0.5	0.09	0.00	72.2	63.1bcd	20.3	5530
FH	0	0.59	0.24	71.2	64.4efg	22.1	6140
	0.125	0.31	0.12	71.8	60.2fgh	21.6	6080
	0.25	0.10	0.04	72.1	58.9h	21.8	6030
	0.5	0.22	0.03	71.6	57.0bc	21.4	5730
MS	0	0.46	0.30	72.4	66.1b	20.9	6890
	0.125	0.28	0.14	72.5	61.2def	21.3	6060
	0.25	0.09	0.02	72.2	57.6gh	22.0	5380
	0.5	0.35	0.08	72.0	57.9gh	21.8	5300

¹ Tebonnet growth stage; EB = early boot, LB = late boot, FH = fully headed, MS = milk stage.

² Differences within columns determined by the Duncan's multiple range test (P<.05).

PLANT GROWTH REGULATOR RESEARCH IN RICE

R. Dunand, R. Dilly, Jr., and G. Meche

Experiment: UBI-1444, UBI-1526, and Red Rice Seedhead Suppression -
Time and Rate of Application Study

Location: Rice Research Station, South Unit

Soil Type/Test Results: Crowley silt loam/none

Variety/Seeding Rate: Tebonnet/200 lb/A

Planting Date: 16 Apr 87

Row Spacing: Broadcast (water-seeded)

Fertilizer: 21-63-63-3.6 (N-P₂O₅-K₂O-ZnSO₄) as 7-21-21-1.2 Zn and 90-0-0 as
urea (46% N) on 13 Apr; soil incorporated

Plot Size: 5 x 30 ft

Treated Area: 5 x 30 ft

Treatments:

Application times: 30 June (Tebonnet at 100% headed), UBI-1444 only
10 July (Tebonnet at milk stage)
15 July (Tebonnet at dough stage)
20 July (Tebonnet at physiological maturity), UBI-1444 only

Application rates: 1.0, 1.5, and 2.0 lb ai/A

Sprayer: CO₂-driven, hand-held, 32 psi, 15 GPA, 80015 nozzles

Pertinent Rainfall: 30 June 1.4 inches within 2 hours of spraying

Herbicide(s): None

Insecticide(s): 0.5 lb/A carbofuran (Furadan) on 14 May

Fungicide(s): 0.17 lb/A propriconazole (Tilt) on 24 June

Emergence: 19 Apr

Permanent Flood: 22 Apr

Drained: 17 July

Harvest Date: 6 and 7 Aug

Harvested Plot Area: 4 x 25 ft

Experimental Design: Randomized complete block (3 replications), factorial
treatment arrangement

Comments: UBI-1444 and UBI-1528, experimental plant growth regulators (PGR), were evaluated for red rice seedhead suppression and impact on rice productivity. Time (based on growth stage of Tebonnet, a very early season rice variety) and rate of application were varied.

An evaluation of mature red rice plants prior to harvest revealed both PGR had been active on red rice, limiting red rice growth and development during the reproductive phase. The results are presented in Table 1.

Number of red rice plants which grew above the rice canopy were documented, and red rice plant density determined. Analysis of the data revealed that time and rate of PGR application affected red rice plant density, independently. The early PGR applications had fewer red rice plants than the late applications as noted in the results with UBI-1444. There were 13, 14, 17, and 19 red rice plants/10 m² observed above the rice canopy with the 100% headed (HD), milk stage (MS), dough stage (DS), and physiological maturity (PM) times of application. Differences between the HD or MS applications and the PM application were statistically significant. Likewise, higher rates of PGR resulted in lower red rice plant densities. There were 21, 17, 13, and 12 plants/m² with 0, 1, 1.5, and 2 lb/A of PGR, respectively. Plant density with the untreated check was significantly lower than with 1 lb/A of PGR, and the 1.5 and 2 lb/A rates of PGR, which were not significantly different, had significantly less red rice plants than the 1 lb/A rate of PGR. The results showed early PGR applications (HD and MS) or high PGR rates (>1.5 lb/A) prevented some red rice plants from obtaining normal plant height above the rice canopy. Since plant density was based on number of red rice plants observed above the canopy of the rice, plant density provided a measure of growth suppression from the PGR treatments as opposed to actual red rice control.

Partially and fully exerted red rice panicles appearing above the rice canopy were documented and red rice panicle density determined. Data analysis revealed that time and rate of PGR affected panicle density, independently. Panicle densities ranged between 25 and 29 panicles/10 m² with the HD, MS, and DS times of application. There was no significant difference between timings. Panicle density averaged 54 panicles/10 m² with the PM time of application and was significantly higher than panicle densities with the earlier application times. For each application time increasing the rate of PGR decreased panicle density. Panicle densities were 57, 34, 20, and 14 panicles/10 m² with the 0, 1, 1.5, and 2 lb/A rates of PGR, respectively. Each increase in PGR rate decreased panicle density significantly below the previous rate up to the 1.5 lb/A rate. There was no significant difference between the 1.5 and 2 lb/A rates. Results with panicle density follow those with plant density indicating that suppressing red rice growth and development below the rice canopy restricts red rice panicle exertion.

The effect of UBI-1444 and UBI-1526 on panicle exertion of individual red rice plants was determined from plant density and panicle density. The results show panicle production on observable red rice plants was dependent on time and rate of PGR application. With only an occasional deviation, PGR rate responses were similar for each application time except PM. In general, the 1, 1.5, and 2 lb/A rate responses were significantly lower than the control, there were no significant difference between the 1 and 1.5 lb/A rate responses, and the 2 lb/A rate response was significantly lower than the 1 lb/A rate response. For

example, UBI-1444 applied at HD resulted in 30, 20, 18, and 10 panicles/10 red rice plants with the 0, 1, 1.5, and 2 lb/A rates, respectively. With the PM time of application there were 31, 31, 28, and 23 panicles/10 plants, for the 0, 1, 1.5, and 2 lb/A rates of PGR, respectively. The differences were not significant. The results showed applications of UBI-1444 at HD, MS, and DS and UBI-1528 applied at MS and DS limit panicle exertion without suppressing red rice growth below the rice canopy. The most effective rate was 2 lb/A.

Interruption of panicle development by PGR discussed above was investigated for subsequent effects on red rice content in harvested grain. The results are presented in Table 2.

Red rice content in harvested grain was determined by counting red rice seed in 50 g grain samples. Red rice seed and Tebonnet grain were differentiated based on size and surface texture. Red rice seed were shorter and thicker than Tebonnet grain, and red rice seed had pubescent lemma and palea (hull) compared to glabrous (smooth) lemma and palea of Tebonnet. The results show grain red rice content was affected by time and rate of application, independently. The MS and DS applications had significantly less red rice in the grain than the HD application, and there was no significant difference between HD and PM times of application. Grain red rice contents were 22, 6, 10, 10, 14, and 16 seed/50 g grain with the HD, MS, DS, and PM times of application, respectively. Grain red rice content decreased with increases in PGR rate. Significant decreases in grain red rice content occurred with each increase in PGR rate up to 1.5 lb/A. There was no significant difference in grain red rice content between the 1.5 and 2 lb/A rates of PGR. On average, grain red rice content was 32, 11, 6, and 3 seed/50 g grain for 0, 1, 1.5, and 2 lb/A rates of PGR, respectively. In general, grain red rice content results parallel those from Table 1 for red rice plant density and panicle density, and offers an explanation for most of the grain red rice content results. Regrowth of red rice occurred with the HD time of application. Regrowth stems produced new panicles which matured late. Normally red rice seed shatters to some degree before harvest, but the late maturing regrowth panicles had little seed shatter, resulting in more seed in the grain. Low red rice seed with the MS time of application indicated the PGR may have had a direct effect on floret fertility.

Red rice content of rough rice was determined by shelling 125 g of rough rice, weighing the shelled red rice, and expressing the amount of red rice as percent of rough rice. During shelling the lemma and palea are removed, and the caryopsis (kernel) remains. The caryopsis of red rice is shorter and thicker than the caryopsis of Tebonnet, and the caryopsis of red rice has a red pericarp (outer layer) compared to a brown pericarp for Tebonnet. The results show rough rice red rice content was affected by time and rate of application, independently. Red rice content was 0.60% with the HD time of application and was significantly higher than red rice content with the other application times. Red rice content ranged from 0.18 to 0.37% with the MS, DS, and PM application times and was not significantly different for those application times. High PGR rates decreased red rice content. Red rice contents were 0.85, 0.28, 0.14, and 0.08% for the 0, 1, 1.5, and 2 lb/A rates of PGR, respectively. All PGR rates decreased red rice content significantly below the control. Red rice content with the 2.0 lb/A rate was significantly lower than

red rice content with the 1.0 lb/A rate, and there was no significant difference in red rice content between the 1 and 1.5 lb/A rates or 1.5 and 2.0 lb/A rates. Numerical trends in the results on rough rice red rice and grain red rice were similar, indicating a majority of the caryopses of red rice seed in the grain were present after shelling. Mature rice is unaffected by shelling, but immature rice crumbles during shelling. Consequently, PGR treatments had no effect on red rice seed development.

Red rice content of rough rice is one of several factors affecting grade, and grade is a determining factor in the unit price of rice. Both time and rate of application of PGR affected grade, independently. Grade was highest (No. 1) with the MS, DS, and PM application times. Grade was slightly lower (No. 2) with the HD application time and was significantly lower than grade with the MS and DS application times. The 1, 1.5, and 2 lb/A rates of PGR improved grade to number 1 over number 2 grade for the untreated check. The difference was statistically significant. Grade and previously discussed rough rice red rice content are in close agreement as expected since grade was based on red rice count. Minor differences occur in the results because grade allows for ranges in red rice content. For example, grade 1 for red rice content allows for up to 0.5% red rice in a rough rice sample.

Application of PGR to limit red rice seed production was studied for its effect on grain production and grain quality. Grain moisture and yield and total and whole milling yields were affected by both time and rate of application. The results are presented in Table 3.

Grain moisture was determined using a Motomco moisture meter. With the MS, DS, and PM times of application, grain moisture ranged between 16.9 and 20.6%, and there were essentially no significant differences between time and rate of application. With the HD time of application, grain moisture ranged from 18.1 to 25.2%, and significant differences were noted between PGR rates. Grain moistures for the 1 and 1.5 lb/A PGR rates were not significantly different at 21.8 and 21.9%, respectively, yet they were significantly higher than the untreated check at 18.1%, and significantly lower than the 2 lb/A PGR rate at 25.2%. Field observations revealed that PGR application at HD resulted in many erect and immature Tebonnet panicles at harvest as determined by green coloration. Green coloration indicated the grain had not matured, explaining the high moisture content.

Grain was harvested using a Suzui small plot combine and grain yield determined by weighing and adjusting grain moisture to 12%. The effects of time and rate of PGR application on grain yield were divided between the earlier and later application times. With the HD application, all PGR rates had significantly lower yields than the corresponding untreated check, and there were no significant differences between the three PGR rates. Grain yields were 6170, 3490, 2940, and 2460 lb/A for the 0, 1, 1.5, and 2 lb/A rates of PGR, respectively. With the MS application grain yield response varied depending on PGR. With UBI-1444 only the 1 lb/A rate was significantly lower than the check. Grain yields were 6460, 4930, 5150, and 5800 lb/A for 0, 1, 1.5 and 2 lb/A rates, respectively. With UBI-1528 only the 1.5 lb/A rate was significantly lower than the check. Grain yields were 6230, 2990, 5040, and 5200 lb/A for 0, 1, 1.5, and 2 lb/A rates, respectively. With the later application times there were no significant differences in grain yield between times

and rates of PGR application. Low grain yield with the HD application is related to the direct effect of PGR on floret fertility and grain formation as indicated by erect panicles and green grain. These effects from PGR application were not noted with other times and rates of application, explaining the insignificant PGR effects with the DS and PM applications, but providing no explanation for the aberrant results noted with the 1 lb/A UBI-1444 and 1.5 lb/A UBI-1526 applications at MS.

Grain was milled to determine the effects of PGR application on milling yield. Grain samples (125 g) were shelled, milled by a Magill mill, and screened to determine total and whole milling yield. Total milling yield was based on weight of rice remaining after milling and whole milling yield was based on weight of rice remaining after screening. Screening removed small and broken pieces of milled rice. The effects of time and rate of PGR application on milling yield were mainly confined to the HD time of application. Both total and whole milling were decreased significantly below the check by all rates of PGR. There were no significant differences between milling yields with the 1, 1.5, and 2 lb/A rates of PGR. With the HD time of application, total milling yields were 72, 66, 67, and 66%, and whole milling yields were 61, 44, 42, and 45% for the 0, 1, 1.5, and 2 lb/A rates of PGR, respectively. In only one other case was milling yield affected. With the MS time of application, UBI-1444 applied at the 2 lb/A rate significantly decreased whole milling yield below the control. Milling yields for the remaining times and rates of PGR application were relatively constant. Total milling yields ranged between 71 and 73%, and whole milling yields ranged between 59 and 63%. Low milling yields with the HD application were related to incomplete grain filling and delayed maturity as previously mentioned. Grain which does not mature correctly breaks during milling and significant amounts of rice are lost. This results in low milling yields as observed in this experiment with the HD application.

UBI-1444 and UBI-1526 exhibited seedhead suppression activity on red rice. Both vegetative and reproductive growth and development were impaired and resulted in lowering red rice seed production. This translated into fewer red rice seed in the harvested grain. Although red rice populations were lower than in previous years and the results were not as dramatic, the activity of the two PGR was consistent with past experiences. Because red rice populations were low, evaluation of PGR effects on the rice crop directly could be made. The results indicate the PGR had little effect on grain moisture and yield and milling yield when applied at milk stage, dough stage, or physiological maturity. Since heading is complete and active grain filling has begun or is near completion at these later growth stages no effects are expected. Earlier application times can have serious consequences. Later maturing red rice begins heading in water-seeded rice when very early season varieties like Tebonnet are at dough stage. Consequently PGR applied during milk and dough stage were more effective than at later growth stages. In addition, the higher rates of PGR tested gave the best results. Of the higher rates, 1.5 and 2 lb/A, the 2 lb/A rate was better although not statistically. There appeared to be no difference in activity of the two PGR.

Table 1. Effect of time and rate of UBI-1444 and UBI-1526 application on red rice stand and reproductive development. Rice Research Station, Crowley, LA. 1987.

Application time (Tebonnet growth stage)	Rate (lb/A)	Plant growth regulator	Plant density (plants/ 10 m ²)	Panicle density (panicles/ 10 m ²)	Plant panicle production (panicles/ 10 plants)
A. Time of Application Effects					
100% headed		UBI-1444	13c ¹	29b	20
Milk stage		UBI-1444	14bc	26b	15
Milk stage		UBI-1526	16abc	25b	14
Dough stage		UBI-1444	17ab	27b	16
Dough stage		UBI-1526	15bc	26b	16
Physiological maturity		UBI-1444	19a	54a	28
B. Rate Effects					
	0		21a	57a	28
	1		17b	34b	20
	1.5		13c	20c	15
	2		12c	14c	10
C. Interactive Effects					
100% headed	0	UBI-1444	20	61	30ab
	1		15	31	20cde
	1.5		10	17	18def
	2		6	7	10fgh
Milk stage	0	UBI-1444	21	68	33a
	1		16	25	16def
	1.5		12	10	9fgh
	2		8	1	2h
Milk stage	0	UBI-1526	24	49	21b-e
	1		17	28	16def
	1.5		11	17	15def
	2		12	6	6gh
Dough stage	0	UBI-1444	20	48	24a-d
	1		19	32	18def
	1.5		15	12	9fgh
	2		13	16	13efg
Dough stage	0	UBI-1526	20	60	31a
	1		14	24	18def
	1.5		12	14	12e-h
	2		14	7	5gh
Physiological maturity	0	UBI-1444	19	58	31a
	1		22	63	31a
	1.5		19	51	28abc
	2		17	44	23a-d

¹ Differences within columns determined by the Duncan's multiple range test (P<.05).

Table 2. Effect of time and rate of UBI-1444 and UBI-1526 application on red rice content of harvested grain. Rice Research Station, Crowley, LA. 1987.

Application time (Tebonnet growth stage)	Rate (lb/A)	Plant growth regulator	Grain red rice content (seed/50g)	Rough rice Red rice content (%)	Grade
A. Time of Application Effects					
100% headed		UBI-1444	22a ¹	0.60a	2a
Milk stage		UBI-1444	6c	0.18b	1b
Milk stage		UBI-1526	10bc	0.26b	1b
Dough stage		UBI-1444	10bc	0.24b	1b
Dough stage		UBI-1526	14b	0.37b	1b
Physiological maturity		UBI-1444	16ab	0.37b	1ab
B. Rate Effects					
	0		32a	0.85a	2a
	1		11b	0.28b	1b
	1.5		6bc	0.14bc	1b
	2		3c	0.08c	1b
C. Interactive Effects					
100% headed	0	UBI-1444	55	1.45	2
	1		16	0.41	1
	1.5		12	0.31	1
	2		6	0.25	1
Milk stage	0	UBI-1444	19	0.63	2
	1		3	0.07	1
	1.5		2	0.02	1
	2		0	0.00	1
Milk stage	0	UBI-1526	16	0.53	2
	1		14	0.33	1
	1.5		6	0.10	1
	2		3	0.07	1
Dough stage	0	UBI-1444	20	0.59	2
	1		9	0.19	1
	1.5		7	0.13	1
	2		3	0.05	1
Dough stage	0	UBI-1526	42	1.03	2
	1		9	0.25	1
	1.5		5	0.19	1
	2		2	0.03	1
Physiological maturity	0	UBI-1444	38	0.86	2
	1		13	0.42	1
	1.5		7	0.11	1
	2		4	0.09	1

¹ Differences within columns determined by the Duncan's multiple range test (P<.05).

Table 3. Effect of time and rate of UBI-1444 and UBI-1526 application on grain production and quality of Tebonnet, a very early season variety.
Rice Research Station, Crowley, LA. 1987.

Application time (Tebonnet growth stage)	Rate (lb/A)	Plant growth regulator	Grain		Milling yield	
			Moisture (%)	Yield (lb/A)	Total (%)	Whole (%)
A. Time of Application Effects						
100% headed		UBI-1444	21.7	3770	68	47
Milk stage		UBI-1444	18.7	5590	71	60
Milk stage		UBI-1526	18.2	5630	72	60
Dough stage		UBI-1444	17.5	6280	72	62
Dough stage		UBI-1526	17.6	5610	72	61
Physiological maturity		UBI-1444	17.9	6230	72	60
B. Rate Effects						
	0		17.5	6240	72	61
	1		19.1	5340	71	57
	1.5		18.9	5250	71	58
	2		19.1	5240	71	57
C. Interactive Effects						
100% headed	0	UBI-1444	18.1de ¹	6170a-e	72abc	61ab
	1		21.7bc	3490g	66d	44c
	1.5		21.9b	2940g	67d	42c
	2		25.2a	2460g	66d	43c
Milk stage	0	UBI-1444	18.2de	6460ab	72abc	63a
	1		20.6bcd	4930f	71c	59ab
	1.5		18.7cde	5150def	71bc	60ab
	2		17.4e	5800a-f	71abc	57b
Milk stage	0	UBI-1526	17.2e	6230a-d	72abc	62ab
	1		17.3e	5990a-f	71abc	59ab
	1.5		19.1b-e	5040ef	71bc	60ab
	2		19.2b-e	5200def	72abc	60ab
Dough stage	0	UBI-1444	17.2e	6730a	72abc	61ab
	1		18.2de	6180a-e	72abc	62a
	1.5		16.6e	6480ab	72abc	62a
	2		18.1de	5720a-f	73ab	63a
Dough stage	0	UBI-1526	17.4e	6390abc	72abc	62ab
	1		18.1de	6180a-e	72abc	60ab
	1.5		17.5e	6400abc	73a	63a
	2		17.4e	5950a-f	73ab	60ab
Physiological maturity	0	UBI-1444	16.9e	5430b-f	72abc	60ab
	1		18.5de	5280c-f	72abc	59ab
	1.5		18.8cde	5510b-f	71bc	60ab
	2		17.3e	6290a-d	72abc	61ab

¹ Differences within columns determined by the Duncan's multiple range test (P<.05).

PLANT GROWTH REGULATOR RESEARCH IN RICE

R. Dunand, R. Dilly, Jr., and G. Meche

Experiment: UBI-1444 and Red Rice Seedhead Suppression - Variety Study

Location: Rice Research Station, South Unit

Soil Type/Test Results: Crowley silt loam/none

Variety/Seeding Rate: See treatments/200 lb/A

Planting Date: 16 Apr 87

Row Spacing: Broadcast (water-seeded)

Fertilizer: 21-63-63-3.6 ($\text{N-P}_2\text{O}_5\text{-K}_2\text{O-ZnSO}_4$) as 7-21-21-1.2 Zn and 90-0-0 as urea (46% N) on 13 Apr; soil incorporated

Plot Size: 5 x 15 ft

Treatment Area: 5 x 15 ft

Treatments:

Application time: Between milk and dough stage

Varieties: Gulfmont treated on 15 July
Lemont treated on 15 July
Mars treated on 20 July
Mercury treated on 15 July
Skybonnet treated on 13 July
Tebonnet treated on 9 July

Application rate: 0 and 2.0 lb/A

Sprayer: CO_2 -driven, hand-held, 32 psi, 15 GPA, 80015 nozzles

Pertinent Rainfall: No rainfall within 3 hours after application

Herbicide(s): None

Insecticide(s): 0.5 lb/A carbofuran (Furadan) on 14 May

Fungicide(s): 0.17 lb/A propriconazole (Tilt) on 24 June

Emergence: 19 Apr

Permanent Flood: 22 Apr

Drained: 31 July

Harvest Date: 17 and 18 Aug

Harvested Plot Area: 1 x 5 ft

Experimental Design: Split plot design (main plot: varieties, subplot: UBI-1444 rate); Randomized complete block (four replications)

Comments: Use of plant growth regulators (PGR) as seedhead suppressants to limit red rice seed production in rice is dependent on the rice variety being earlier maturing than red rice. This experiment was conducted to determine which of the currently popular varieties grown are sufficiently different in maturity from red rice to be suitable for use with seedhead suppressants.

UBI-1444 was applied between milk and dough stage of six varieties, and the effects on red rice stand and panicle production and rice grain production were determined. The results are presented in Table 1.

The number of red rice plants and red rice panicles observed above the rice canopy at maturity were documented, and red rice stand density, panicle density, and plant panicle production (panicles per plant) determined. The results show red rice stand densities were similar regardless of variety or PGR rate. However, panicle density and plant panicle production were affected by both. All varieties except Mars had significantly fewer red rice panicles per unit area and per plant when treated with PGR. For example, Gulfmont not treated with PGR had 67 panicles/10 m² compared to 12 panicles/10 m² with Gulfmont treated with PGR. Mars had 21 and 26 panicles/10 m² with no PGR and with PGR, respectively. Plant panicle production averaged 25 and 3 panicles/10 plants for Gulfmont without and with PGR, respectively, and plant panicle production for Mars was 14 and 12 panicles/10 plants without and with PGR, respectively. The results indicate maturity differences between red rice and all varieties tested except Mars were sufficient for PGR application to suppress red rice panicle exertion.

The effect of PGR application for red rice seedhead suppression on grain production of the six varieties was determined. Grain moisture and yield were evaluated and only grain moisture was affected. Varietal differences affected grain moisture and this was the result of inherent maturity differences. The very early maturing varieties, Skybonnet and Tebonnet, had significantly lower grain moistures than the other varieties. Grain moistures were 12.7 and 12.8% for Skybonnet and Tebonnet, respectively, compared to 13.3 to 13.8% for Gulfmont, Lemont, Mars, and Mercury. UBI-1444 applied at milk to dough stage in the six varieties had no significant effect on grain yield.

It can be concluded that UBI-1444 can be successfully used to suppress red rice panicle production in most of the currently popular rice varieties grown in the southern rice area. The varieties are Gulfmont, Lemont, Mercury, Skybonnet, and Tebonnet. Mars, an early season medium grain, is unsuited.

Table 1. The effect of UBI-1444 on red rice stand and panicle production and grain production of six rice varieties. Rice Research Station, Crowley, LA. 1987.

Variety	UBI-1444 (lb/A)	Red rice			Grain	
		Plant density (plants/ 10 m ²)	Panicle density (panicles/ 10 m ²)	Plant panicle production (panicles/ 10 plants)	Moisture (%)	Yield (lb/A)
A. Variety Effects						
Gulfmont		29	40	14	13.3b	5970
Lemont		24	29	11	13.3b	6730
Mars		18	24	13	13.8a	7000
Mercury		23	31	11	13.4ab	7250
Skybonnet		32	42	14	12.7c	5650
Tebonnet		26	27	8	12.8c	5560
B. Rate Effects						
	0	27	52	19	13.3	6490
	2	23	12	5	13.1	6230
C. Interactive Effects						
Gulfmont	0	27	67a ¹	25a	13.6	6220
	2	31	12c	3e	12.8	5710
Lemont	0	27	50ab	17bcd	13.3	7340
	2	21	7c	4e	13.2	6110
Mars	0	17	21c	14cd	13.9	6520
	2	18	26bc	12d	13.7	7470
Mercury	0	29	58a	21abc	13.3	7200
	2	18	19c	2e	13.6	7300
Skybonnet	0	30	65a	24ab	12.8	5740
	2	34	19c	4e	12.6	5560
Tebonnet	0	33	48ab	14cd	12.8	5890
	2	19	6c	3e	12.8	5230

¹ Differences within columns determined by the Duncan's multiple range test (P<.05).

PLANT GROWTH REGULATOR RESEARCH IN RICE

R. Dunand, R. Dilly, Jr., and G. Meche

Experiment: Fenoxaprop and Red Rice Control - Time and Rate of Application Study

Location: Rice Research Station, South Unit

Soil Type/Test Results: Crowley silt loam/none

Variety/Seeding Rate: Tebonnet/200 lb/A

Planting Date: 16 Apr 87

Row Spacing: Broadcast (water-seeded)

Fertilizer: 21-63-63-3.6 (N-P₂O₅-K₂O-ZnSO₄) as 7-21-21-1.2 Zn and 90-0-0 as urea (46% N) on 13 Apr; preplant incorporated

Plot Size: 5 x 30 ft

Treated Area: 5 x 30 ft

Treatments:

1. Check
2. Whip (0.15 lb ai/A) at 4-5 leaf stage of Lemont
3. Whip (0.15 lb ai/A) at 4-5 leaf stage of Lemont + Whip (0.20 lb ai/A) at late tiller stage of red rice
4. Whip (0.20 lb ai/A) at 4-5 leaf stage of Lemont
5. Whip (0.20 lb ai/A) at 4-5 leaf stage of Lemont + Whip (0.20 lb ai/A) at late tiller stage of red rice
6. Whip (0.20 lb ai/A) at late tiller stage of red rice
7. Whip (0.15 lb ai/A) + crop oil concentrate (1 qt/A) at 4-5 leaf stage of Lemont
8. Whip (0.15 lb ai/A) + Embark (0.03 lb ai/A) at 4-5 leaf stage of Lemont
9. Whip (0.15 lb ai/A) + Embark (0.03 lb ai/A) + crop oil concentrate (1 pt/A) at 4-5 leaf stage of Lemont

Note: 4-5 leaf stage Lemont occurred on 12 May; late tiller red rice occurred on 8 June.

Sprayer: CO₂-driven, hand-held, 32 psi, 15 GPA, 80015 nozzles

Pertinent Rainfall: No rainfall within 3 hours following application

Herbicide(s): none

Insecticide(s): 0.5 lb/A carbofuran (Furadan) on 14 May

Fungicide(s): 0.17 lb/A propriconazole (Tilt) on 24 June

Emergence: 19 Apr

Permanent Flood: 22 Apr

Drained: 31 July

Harvest Date: 13 Aug

Harvested Plot Area: 2 (1 x 4 ft)

Experimental Design: Randomized complete block (4 replications)

Comments: Whip alone and in combination with additives was applied to Lemont water-seeded in an area naturally infested with red rice to determine the effect on red rice and crop tolerance. The results of Whip effects on red rice and Lemont are presented in Tables 1 and 2, respectively.

Whip was evaluated for its effects on red rice stand, panicle density, and plant panicle production. Red rice stand, panicle density, and plant panicle production were determined based on red rice plants and panicles observed above the rice canopy at maturity.

Whip decreased red rice stand and panicle density and did not affect plant panicle production. The results in Table 1 show all Whip treatments decreased red rice stand and panicle density significantly below the untreated check. Whip, in combinations with crop oil concentrate (COC) and multiple Whip applications, had the most significant effect. Red rice stand densities were 3, 4, 5, and 5 plants/10 m² with Whip + COC, Whip + Whip (1), Whip + Whip (2), and Whip + Embark + COC, respectively. Whip in combination with Embark and single Whip applications had the least significant effect. Red rice stand densities were 8, 8, 9, and 10 plants/10 m² with Whip + Embark, Whip (2), Whip (1), and Whip (3), respectively. The untreated check had 16 plants/10 m². Panicle density results followed similar trends as those noted with plant density. Red rice panicle densities were 6, 9, 9, and 10 panicles/10 m² with Whip + COC, Whip + Whip (1), Whip + Whip (2), and Whip + Embark + COC, respectively, and red rice panicle densities were 15, 17, 18, and 28 panicles/10 m² with Whip + Embark, Whip (1), Whip (2), and Whip (3), respectively. The untreated check had 43 panicles/10 m². The results indicate Whip reduced red rice competition by reducing red rice population or limiting red rice development below the rice canopy. Also, in this way red rice panicle production was reduced. Whip had no direct effect on panicle production as evidenced by the plant panicle production results.

The effect of Whip on crop growth, development, and productivity at maturity was determined by evaluating plant height, stand, yield components, and grain yield and moisture. The results are presented in Table 2.

In general, Whip decreased Lemont growth and development. Of the Whip treatments, Whip in combination with COC decreased height most, and single and multiple Whip applications decreased plant height least. Plant height was 27 inches with Whip + COC and Whip + Embark + COC. Plant heights were 28, 29, 29, and 29 inches with Whip + Whip (1), Whip + Whip (2), Whip + Embark, and Whip (3), respectively. Plant heights with Whip (2) and the untreated check were 30 and 31 inches, respectively. Statistically, plant height was most significantly decreased with Whip in combination with COC. Plant heights with Whip + Embark, Whip (3), and Whip (1) were significantly taller than Whip in combination with COC yet significantly shorter than the untreated check.

In addition, Whip decreased crop growth and development as indicated by the effect of Whip on stand. Lemont stands were lowest with Whip + COC. Intermediate stands resulted with multiple Whip applications at 0.2 lb ai/A and highest stands resulted with single and multiple Whip applications at 0.15 lb ai/A. Lemont stands were 13 plants/ft² with Whip + COC and Whip + Embark + COC and 16 plants/ft² with Whip + Whip (2). Lemont stands were 18, 18, 18, 19, 19, and 21 plants/ft² with the untreated check, Whip (1), Whip (2), Whip + Embark, Whip + Whip (1), and Whip (3), respectively. Statistically, Lemont stands were not significantly affected by Whip (1), Whip (2), Whip (3), Whip + Embark, or Whip + Whip (1). Lemont stands with Whip + Whip (2) were significantly less than the untreated check, and Lemont stands with Whip in combination with COC were significantly less than with Whip + Whip (2).

Overall, Lemont productivity was decreased by Whip as evaluations of yield components and grain yield and moisture indicate. The results are presented in Table 2.

A major yield component in rice is panicles per unit area. Number of panicles per unit area is dependent on stand and panicles per plant. Like the effects of Whip on stand, a few Whip treatments had a negative effect on the reproductive development of individual Lemont plants. Panicle production of individual rice plants was decreased significantly with a single application of the high rate (0.2 lb ai/A) of Whip applied during the 4-5 leaf stage of Lemont and with Whip in combination with COC. Individual plant panicle production was 25, 26, and 26 panicles/plant with Whip + COC, Whip + Embark + COC, and Whip (2), respectively. Other Whip treatments had no significant affect on individual plant panicle production. Individual plant panicle production was 27, 29, 30, 30, 30, and 32 panicles/plant with Whip (3), Whip + Whip (2), Whip + Embark, Whip + Whip (1), Whip (1), and the untreated check, respectively.

The effects of Whip on individual plant panicle production in combination with the previously mentioned effects of Whip on Lemont stand influenced Lemont panicle density. Panicle density was lowest² with Whip in combination with COC. Panicle densities were 31 and 34 panicles/ft² with Whip + COC and Whip + Embark + COC, respectively. Intermediate panicle densities resulted with the high rate (0.2 lb ai/A) of Whip applied during the 4-5 leaf stage of Lemont. Panicle densities were 45 and 46 panicles/ft² with Whip + Whip (2) and Whip (2), respectively. Panicle densities not significantly different from the untreated check occurred with Whip applied at the low rate (0.15 lb ai/A) during the 4-5 leaf stage of Lemont and with Whip applied at late tillering of red rice. Panicle densities were 53, 54, 55, 57, and 58 panicles/ft² with Whip (1), Whip + Whip (1), Whip (3), Whip + Whip (2), and the untreated check, respectively.

In addition to panicle density, panicle grain production and individual grain size are other yield components of importance. The number of grains per panicle in combination with panicle density determine number of grains per unit area. In turn, grains per unit area and grain size determine grain yield.

Panicle grain production was reduced significantly with Whip in combination with COC (Table 2). Panicle grain production was 37 grains/panicle with Whip + COC compared to 51 grains/panicle with the untreated check. Panicle grain production with the other Whip treatments ranged between 39 and 51 grains/panicle and were not significantly different from the untreated check. Panicle grain production and grain size are inversely related in rice. Consequently, grain size was high with Whip in combination with COC. There was

no significant difference from the untreated check, although grain sizes from treatments with Whip in combination with COC were significantly higher than grain sizes from treatments with the high rate (0.2 lb ai/A) of Whip applied at the 4-5 leaf stage of Lemont, multiple applications of Whip, and Whip in combination with Embark. Grain sizes, expressed as 1000-grain weight, were 27.4 and 27.5 g with Whip + COC and Whip + Embark + COC, respectively. Grain sizes ranged between 26.5 and 27.1 g with the other Whip treatments and the untreated check.

Grain yield is the sum of yield components and was likewise affected by Whip. Grain yield was decreased significantly below the untreated check by all Whip treatments except the high rate (0.2 lb ai/A) of Whip applied at the late tiller stage of red rice. Grain yields were 7280 and 6720 lb/A with the untreated check and Whip (3), respectively. Of the Whip treatments, Whip in combination with COC decreased grain yield most. Grain yields were 2920 and 3310 lb/A with Whip + COC and Whip + Embark + COC, respectively. Whip applied at the 4-5 leaf stage of Lemont and multiple applications of Whip resulted in higher grain yields than Whip with COC but lower grain yields than the untreated check. Grain yields were 5230, 5640, 5840, 5960, and 6170 lb/A with Whip + Whip (2), Whip (2), Whip + Embark, Whip + Whip (1), and Whip (1), respectively. Maturity was delayed by Whip as noted by delayed heading. Heading dates were not recorded. Grain moisture, which is another measure of maturity, was unaffected by Whip application and ranged from 15.1 to 15.7%. Delayed harvest as indicated by low grain moisture prevented detecting differences in maturity by grain moisture.

Whip can control red rice in rice. Whip alone can provide approximately 50% red rice control. Multiple applications of Whip and Whip in combination with crop oil concentrate can provide approximately 80% red rice control. There appears to be no effect of Whip on red rice reproductive development (panicle production) except an indirect effect through stand reduction.

Whip effects on crop productivity were inversely related to the Whip effects on red rice control. Whip treatments resulting in highest red rice control (Whip + COC) had lowest crop productivity. Apparently rice and red rice are similar biologically, and the herbicidal activity of Whip affects rice growth and development and is detrimental to crop productivity. The sensitivity of rice to Whip is less than that of red rice because rice stands were affected less by Whip than red rice stands. Rice is most tolerant to Whip when applied at low rates (0.15 compared to 0.2 lb ai/A) and late vegetative growth stages (late tillering of red rice which is near panicle initiation of Lemont compared to 4-5 leaf stage Lemont, a four week difference in time). In conclusion, Whip (0.15 lb ai/A) applied at late tillering of red rice can provide statistically significant red rice control with statistically insignificant effects on crop productivity, and application of Whip in combination with crop oil concentrate to seedling rice can be devastating to crop productivity.

Table 1. Effect of Whip and additives on red rice development in water-seeded rice. Rice Research Station, Crowley, LA. 1987.

Treatment ¹	Rate (lb ai/A)	Timing ²	Stand density (plants/10 m ²)	Panicle production	
				Panicle density (panicles/10 m ²)	Plant panicle production (panicles/10 plants)
Check	--	--	16a ³	43a	28
Whip (1)	0.15	A	9bc	17c	20
Whip (2)	0.20	A	8bc	18c	23
Whip (3)	0.20	B	10b	28b	28
Whip +	0.15	A	4cd	9cd	20
Whip (1)	0.20	B			
Whip +	0.20	A	5cd	10cd	21
Whip (2)	0.20	B			
Whip +	0.15	A	8bc	15cd	21
Embark	0.03				
Whip +	0.15	A	3d	6d	15
COC	1 qt/A				
Whip +	0.15	A	5cd	9cd	20
Embark +	0.03				
COC	1 pt/A				

¹ COC = crop oil concentrate.

² A = 4-5 leaf stage Lemont.

B = late tiller red rice.

³ Differences within columns determined by the Duncan's multiple range test (P<.05).

Table 2. Effect of Whip and additives for red rice control on water-seeded Lemont. Rice Research Station, Crowley, LA. 1987.

Treatment ¹	Rate (lb ai/A)	Timing ²	Plant height (in)	Stand (plants/ ft ²)	Panicle density/ (panicles/ ft ²)	Plant panicle production (panicles/ plant)	Panicle grain production (grains/ panicle)	1000- grain weight (g)	Grain	
									Yield (lb/A)	Moisture (%)
Check	--	--	31a ³	18abc	58a	32a	51a	27.1ab	7280a	15.6
Whip (1)	0.15	A	29bc	18bc	53ab	30ab	47ab	26.9ab	6170bc	15.5
Whip (2)	0.20	A	30ab	18abc	46b	26b	51a	27.0ab	5640c	15.4
Whip (3)	0.20	B	29bc	21a	55a	27ab	50a	26.6bc	6720ab	15.7
Whip + Whip (1)	0.15 0.20	A B	28cd	19ab	54a	30ab	46ab	26.2c	5960bc	15.6
Whip + Whip (2)	0.20 0.20	A B	29bcd	16c	45b	29ab	47ab	26.5bc	5230c	15.7
Whip + Embark	0.15 0.03	A	29bc	19ab	57a	30ab	42ab	26.6bc	5840bc	15.4
Whip + COC	0.15 1 qt/A	A	27d	13d	31c	25b	37b	27.4a	2920d	15.1
Whip + Embark + COC	0.15 0.03 1 pt/A	A	27cd	13d	34c	26b	39ab	27.5a	3310d	15.6

¹ COC = crop oil concentrate.

² A = 4-5 leaf stage Lemont.

B = late tiller red rice.

³ Differences within columns determined by the Duncan's multiple range test (P<.05).

PLANT GROWTH REGULATOR RESEARCH IN RICE

R. Dunand, R. Dilly, Jr., and G. Meche

Experiment: Fenoxaprop and Red Rice Control - Seeding Rate Study

Location: Rice Research Station, South Unit

Soil Type/Test Results: Crowley silt loam/none

Variety/Seeding Rate: Tebonnet/see treatments

Planting Date: 16 Apr 87

Row Spacing: Broadcast (water-seeded)

Fertilizer: 21-63-63-3.6 (N-P₂O₅-K₂O-ZnSO₄) as 7-21-21-1.2 Zn and 90-0-0 as urea (46%) on 13 Apr; preplant incorporated

Plot Size: 5 x 30 ft

Treated Area: 5 x 30 ft

Treatments:

Application time: 12 May (Tebonnet at early tiller)

Application rates: 0, 0.15 lb ai/A

Seeding rates: 50, 100, and 200 lb/A

Sprayer: CO₂-driven, hand-held, 32 psi, 15 GPA, 80015 nozzles

Pertinent Rainfall: No rainfall within 24 hours following application

Herbicide(s): None

Insecticide(s): 0.5 lb/A carbofuran (Furadan) on 14 May

Fungicide(s): 0.17 lb/A propriconazole (Tilt) on 24 June

Emergence: 19 Apr

Permanent Flood: 22 Apr

Drained: 24 July

Harvest Date: 3 Aug

Harvested Plot Area: 4 x 27 ft

Experimental Design: Randomized complete block (4 replications); factorial treatment arrangement

Comments: Whip for red rice control in rice can decrease rice production by decreasing stand and various yield components. Seeding rate in combination with Whip applied during the seedling stage of rice was investigated to determine the effects on red rice control and crop productivity. The results are presented in Table 1.

Whip and Tebonnet seeding rate affected red rice independently. Whip decreased red rice stand and panicle density significantly and increases in Tebonnet seeding rate caused significant decreases in red rice stand and panicle density. Red rice stand densities were 28 and 14 plants/10 m² with the untreated check and Whip treatment, respectively, and red rice panicle densities were 79 and 23 panicles/10 m² with the untreated check and Whip treatment, respectively. Red rice stand density with the 50 lb/A Tebonnet seeding rate was significantly higher than stand density with the 200 lb/A seeding rate. Stand density with the 100 lb/A seeding rate was not significantly different from the 50 or 200 lb/A seeding rates. Red rice stand densities were 24, 21, and 18 plants/10 m² with the 50, 100, and 200 lb/A seeding rates, respectively. Each doubling of seeding rate caused a significant decrease in red rice panicle density. Panicle densities were 75, 47, and 31 red rice panicles/10 m² with the 50, 100, and 200 lb/A seeding rates, respectively.

Whip had negative effects on Tebonnet growth and productivity as measured by plant height and grain moisture and yield. Seeding rate effects were positive. Whip reduced plant height and delayed maturity significantly. Without Whip, plant height averaged 80 cm, and with Whip plant height averaged 78 cm. High grain moisture at harvest indicates delayed maturity. Grain moisture averaged 18.8% without Whip and 20.1% with Whip. Doubling seeding rate had no effect on plant height and hastened maturity. Plant heights with the 50, 100, and 200 lb/A seeding rates were 79, 79, and 78 cm, respectively. With the 50, 100, and 200 lb/A seeding rates, grain moistures were 20.8, 19.2, and 18.4%, respectively. Grain moisture with the 50 lb/A seeding rate was significantly higher than grain moisture with the 100 and 200 lb/A seeding rates. There was no significant difference between grain moisture with the 100 and 200 lb/A seeding rates. In general, Whip decreased grain yield and seeding rate increased grain yield. To a significant degree, the negative effects of Whip on grain yield were offset by seeding rate. Without Whip, grain yields were 5310, 6560, and 6710 lb/A with the 50, 100, and 200 lb/A seeding rates, respectively. Grain yield at the 50 lb/A seeding rate was significantly lower than grain yield at the 100 and 200 seeding rates. Grain yields with the 100 and 200 lb/A seeding rates were not significantly different. In contrast, with Whip, grain yields were 4000, 5430, and 6370 lb/A with the 50, 100, and 200 lb/A seeding rates, respectively. Grain yield with the 50 lb/A seeding rate was significantly lower than grain yield with the 100 lb/A seeding rate, and grain yield with the 100 lb/A seeding rate was significantly lower than grain yield with the 200 lb/A seeding rate. Only at the 200 lb/A seeding rate was there no significant difference between grain yields with or without Whip.

As noted in previous experiments, Whip applied during the seedling stage can provide approximately 50% red rice control in rice with a resultant 70% reduction in red rice panicle production. A very early season variety like Tebonnet experiences minor stunting and delayed maturity of a few days from a seedling application of Whip. Crop tolerance to Whip as evidenced by grain yield is acceptable if seeding rate is high (200 lb/A). Currently recommended seeding rates for water-seeded rice range from 135 to 150 lb/A.

Table 1. Effect of Whip and seeding rate on red rice and Tebonnet. Rice Research Station, Crowley, LA. 1987.

Whip (lb ai/A)	Seeding rate (lb/A)	Red rice		Tebonnet			
		Stand density (plants/10 m ²)	Panicle density (panicles/10 m ²)	Plant height (cm)	Grain		
					Moisture (%)	Yield (lb/A)	
0 0.15	0 100 200	28a ^{1/} 14b	A. Whip Effects				
			79a 23b	80a 78b	18.8b 20.1a	6190 5270	
	50 100 200	24 21 18	B. Seeding Rate Effects				
			75a 47b 31c	79 79 78	20.8a 19.2b 18.4b	4660 5990 6540	
0	50 100 200	31 29 24	C. Interactive Effects				
			120 75 44	79 80 79	19.8 18.6 18.1	5310b 6560a 6710a	
0.15	50 100 200	17 13 11					
			32 20 17	77 77 78	21.7 19.9 18.7	4000c 5430b 6370a	

^{1/} Differences within columns determined by the Duncan's multiple range test (P<.05).

PLANT GROWTH REGULATOR RESEARCH IN RICE

R. Dunand, R. Dilly, Jr., and G. Meche

Experiment: Gibberellin-Enhanced Emergence in Rice

Location: Rice Research Station, North Unit

Soil Type/Test Results: Crowley silt loam/none

Variety/Seeding Rate: See treatments

Planting Date: 29 Apr 87

Row Spacing: 7 in

Fertilizer: 21-63-63-3.6 ($\text{N-P}_{205}\text{-K}_2\text{O-ZnSO}_4$) as 7-21-21-1.2 Zn on 27 Apr; 100 and 140 lb N/A as urea (46%) on 1 June for Tebonnet and Lemont, respectively; 42-0-0 as ammonium sulfate (21% N) on 2 July and 7 July

Plot Size: 3.5 x 20 ft

Treated Area: 3.5 x 20 ft

Treatments:

Varieties: Lemont, Tebonnet

Seeding rates: 50, 100 lb/A

Seeding depth: 0.5, 3 in

Gibberellin concentration: 0, 10, 100 ppm (applied as dust to seed and concentration based on weight)

Herbicide(s): 3 lb/A propanil (Stampede) on 20 May and 3 June

Insecticide(s): 0.5 lb/A carbofuran (Furadan) on 16 June

Fungicide(s): 0.17 lb/A propriconazole (Tilt) on 2 and 16 July

Emergence: 5 May through 11 May depending on treatment

Water Management: 0.5 inch planting depth flushed on 30 Apr and all treatments flushed on 21 May; Permanent flood on 4 June

Harvest Date: none

Harvested Plot Area: none

Experimental Design: Randomized complete block (4 replications); split plot design with seeding depth assigned to main plots and seeding rate and gibberellin concentration in a factorial arrangement assigned to subplots

Comments: Following planting, emergence in all treatments was noted after 10 days. Emergence counts were recorded between 10 and 15 days after planting, and a final stand count was taken 24 days after planting. The effects of variety, seeding depth and rate and gibberellin (GA) seed treatment on emergence and final stand are presented in Table 1.

Varietal effects were independent of seeding depth and rate and GA concentration. Emergence and final stand of Tebonnet were significantly higher than Lemont. On average, there were 134 and 105 plants/m² for Tebonnet and Lemont, respectively.

In general, emergence and final stand were highest at the shallow seeding depth, at the high seeding rate and with GA treated seed. On average, emergence and final stand were 165 and 74 plants/m² for the 0.5 and 3 inch planting depths, respectively; 80 and 159 plants/m² for the 50 and 100 lb/A seeding rates, respectively; and 110, 120 and 129 plants/m² for the 0, 10, and 100 ppm GA seed treatments, respectively.

However, the effects of seeding depth and rate and GA concentration on emergence and final stand were interdependent. At the shallow seeding depth, emergence and final stand were twice as high at the higher seeding rate, and GA seed treatments had no effect. At the 50 lb/A seeding rate, emergence and final stand together averaged 126, 114, and 116 plants/m² with 0, 10, and 100 ppm GA, respectively. At the 100 lb/A seeding rate, emergence and final stand together averaged 228, 230, and 223 plants/m² with 0, 10, and 100 ppm GA, respectively. In comparison, at the deep seeding depth, emergence and final stand were again twice as high at the high seeding rate, and GA seed treatment affected emergence and final stand differently depending on seeding rate. At the 50 lb/A seeding rate, 10 ppm GA had little impact on emergence and final stand, while 100 ppm GA had a significant effect. On average emergence and final stand together averaged 50, 62, and 71 plants/m² with the 0, 10, and 100 ppm GA seed treatments, respectively. In contrast, at the 100 lb/A seeding rate, emergence and final stand were increased significantly as GA concentration increased by the power of 10. On average, emergence and final stand together averaged 71, 119, and 141 plants/m² with the 0, 10, and 100 ppm GA seed treatments, respectively.

The results show that both Lemont, a semidwarf, early season rice cultivar, and Tebonnet, a tall, very early season rice cultivar, are responsive to GA seed treatment. Adequate stands (100-200 plants/m²) can be obtained planting 3 inches below the soil surface using 10 and 100 ppm GA seed treatments. Compared to most rice cultivars, Lemont and Tebonnet have poor emergence in a drill-seeded system. In particular Lemont because of its semidwarf nature has limited elongation of the mesocotyl and coleoptile and must be planted shallow. Soil moisture levels at shallow depths are usually inadequate to allow germination. A common practice which is used is to flush fields of shallow-seeded rice. This involves flooding fields to surface coverage and draining as quickly as possible. Flushing provides moisture for germination and usually requires being repeated 7 to 10 days later to soften the dried soil surface and allow emergence.

There are several complications which arise with flushing. Rain following flushing or poor drainage (in general or low areas called pot holes) can keep soil water-logged for an extended period. Under these conditions the seed rot,

and poor stands result. Should weather conditions become dry as they did in 1987 and the soil surface harden too quickly following the initial flushing, then additional flushings are required to keep the soil moist for adequate emergence. This past season fields were flushed 4 to 5 times before emergence was complete. The benefits of GA seed treatment would be to eliminate the cost and complications associated with flushings.

Table 1. The effect of gibberellin (GA) seed treatment on emergence and final stand of Lemont and Tebonnet varying seeding depth and rate. Rice Research Station, Crowley, LA. 1987.

Variety	Seeding		GA conc. (ppm)	Days after planting						Avg.
	Depth (in)	Rate (lb/A)		10	11	12	14	15	24	
				-----plants/m ² -----						
A. Main Effects										
Tebonnet				56a ¹	93a	124a	167a	185a	180a	134a
Lemont				20b	53b	88b	155b	160b	165b	105b
	0			60	110	148	210	232	228	165
	3			15	36	64	100	113	117	74
		50		26	47	71	103	114	117	80
		100		50	99	141	207	231	228	159
			0	30	64	93	143	162	165	110
			10	37	69	106	158	175	174	120
			100	46	87	120	164	180	178	129
B. Interactive Effects										
	0	50	0	41b	81b	106bc	151c	164c	167cd	126bc
			10	41b	64b	100bc	140c	155c	152d	114c
			100	49b	78b	102bc	137c	148c	151d	116c
		100	0	68a	140a	189a	284a	316a	314a	228a
			10	84a	146a	193a	285a	311a	300ab	230a
			100	82a	154a	196a	266a	294a	286b	223a
	3	50	0	5c	13d	29e	53e	62e	65g	42f
			10	6c	17d	32de	59e	69e	80fg	50ef
			100	13c	29cd	56d	78de	84de	87f	62de
		100	0	7c	21d	47de	85d	106d	114e	71d
			10	17c	48c	97c	147c	166c	166cd	119c
			100	42b	86b	125b	176b	193b	186c	141b

¹ Differences within columns determined by the Duncan's multiple range test (P<.05).

PLANT GROWTH REGULATOR RESEARCH IN RICE

R. Dunand, R. Dilly, Jr., and G. Meche

Experiment: Gibberellin-Induced Seedling Elongation in Rice

Location: Rice Research Station, North Unit

Soil Type/Test Results: Crowley silt loam/none

Variety/Seeding Rate: Lemont/85 lb/A

Planting Date: 28 Apr 87

Row Spacing: 7 in

Fertilizer: 21-63-63-3.6 (N-P₂O₅-K₂O-ZnSO₄) as 7-21-21-1.2 Zn on 28 Apr, 140 lb N/A as urea (46% N) on 1 June and 42-0-0 as ammonium sulfate (21% N) on 2 and 7 July

Plot Size: 6 x 35 ft

Treated Area: 6 x 35 ft

Treatments:

Application times: 13 May (Lemont at first leaf)
18 May (Lemont at 2-3 leaf)
22 May (Lemont at 3-4 leaf)

Application rate: 0.01 lb ai/A (64 g Pro-Gibb/A)

Sprayer: CO₂-driven, hand-held, 32 psi, 15 GPA, 80015 nozzles

Pertinent Rainfall: 13 May - 0.5 in. rain 1 hr after application
18 May - no rain
22 May - 1 in. rain 5 hr after application

Herbicide(s): 3 lb/A propanil (Stampede) on 20 May and 3 June

Insecticide(s): 0.5 lb/A carbofuran (Furadan) on 16 June

Fungicide(s): 0.17 lb/A propriconazole (Tilt) on 2 and 17 July

Emergence: 9 May

Water Management: Flushed on 30 Apr and 21 May; Permanent flood on 4 June

Harvest Date: 26 Aug

Harvested Plot Area: 6 x 32 ft

Experimental Design: Randomized complete block (4 replications)

Comments: The effects of gibberellin (GA) applied during the seedling stages to rice are presented in Table 1. Plant height measurements taken following application show seedling height was increased with no effect on mature plant height, maturity or grain yield.

Plant height was increased significantly by applications of GA at the 2-3 and 3-4 leaf stages of growth. At 29 days after planting (DAP), plant height for the 2-3 leaf application was significantly higher than the other treatments. Plant height for the 3-4 leaf and 1-2 leaf and 3-4 leaf combination applications, although significantly less than plant height for the 2-3 leaf application was significantly higher than plant height for the 1-2 leaf application and untreated check. Plant heights were 14, 13, 13, 10, and 9 inches for the 2-3 leaf, 3-4 leaf, 1-2 and 3-4 leaf combination and 1-2 leaf applications, and the untreated check, respectively. Seven days later at 36 DAP, plant height was highest for the 3-4 leaf and 1-2 and 3-4 leaf combination applications followed by the 2-3 leaf and 1-2 leaf applications and the untreated check. Plant height for treatments with the 3-4 leaf application was significantly higher than the other treatments, and plant height for the 2-3 leaf application was significantly higher than the 1-2 leaf application and untreated check. Plant heights for the 1-2 leaf application and untreated check were not significantly different. Plant heights were 18, 18, 15, 11, and 11 inches for the 3-4 leaf, 1-2 leaf and 3-4 leaf combination, 2-3 leaf and 1-2 leaf applications, and the untreated check, respectively.

Mature plant height and grain moisture and yield were not significantly affected by seedling applications of GA. Mature plant height was 31 inches for each treatment. Grain moisture ranged between 20.5 and 21.3% and grain yield ranged between 6700 and 7080 lb/A for all treatments.

Semidwarf rice varieties like Lemont are short during the seedling stages. In order to avoid submerging seedling Lemont plants, the permanent flood is delayed many days longer than with tall cultivars which are taller than Lemont during the seedling stages. Delaying the flood leads to weed control problems which require herbicides with residual activity or multiple herbicide applications. Also early flooding allows vigorous seedling growth and early crop maturity. The results from this study indicate that GA applications to seedling Lemont can increase seedling height to allow early flooding. The semidwarf plant type is unaffected at maturity providing lodging resistance and there is no direct adverse effects on crop maturity or yield.

Table 1. The effect of foliar gibberellin (6.4 g/A) on seedling height and agronomic factors at maturity of Lemont. Rice Research Station, Crowley, LA. 1987.

Application time (GS ¹ -DAP ²)	Seedling height		Mature plant height (in)	Grain	
	DAP	DAP		Moisture	Yield
	----- (in) -----			(%)	(lb/A)
CK	9c ³	11c	31	20.5	6780
1st leaf - 15	10c	11c	31	21.0	7080
2-3 leaf - 20	14a	15b	31	21.3	6830
3-4 leaf - 24	13b	18a	31	21.0	6760
1st + 3-4 leaf - 15 + 24	13b	18a	31	20.9	6700

¹ Growth stage.

² Days after planting.

³ Differences within columns determined by the Duncan's multiple range test (P<.05).

PLANT GROWTH REGULATOR RESEARCH IN RICE

R. Dunand, R. Dilly, Jr., and G. Meche

Experiment: AC-94377 Emergence Enhancement in Rice

Location: Rice Research Station, North Unit

Soil Type/Test Results: Crowley silt loam/none

Variety/Seeding Rate: Lemont/85 lb/A

Planting Date: 28 Apr 87

Row Spacing: 7 in

Planting Depth: 3 in

Fertilizer: 21-63-63-3.6 (N-P₂O₅-K₂O-ZnSO₄) as 7-21-21-1.27n on 27 Apr,
140-0-0 as urea (46% N) on 1 June and 42-0-0 as ammonium sulfate
(21% N) on 2 July and 7 July

Plot Size: 3.5 x 25 ft

Treated Area: 3.5 x 25 ft

Treatments:

1. Check

Following treatments applied as dust to seed and concentration based on weight.

2. 500 ppm ai AC-94377
3. 500 ppm blank
4. 1000 ppm ai AC-94377
5. 1000 ppm blank
6. 1500 ppm ai AC-94377
7. 1500 ppm blank
8. 2000 ppm ai AC-94377
9. 2000 ppm blank
10. 3000 ppm ai AC-94377
11. 3000 ppm blank
12. 10 ppm gibberellin
13. 100 ppm gibberellin

Herbicide(s): 3 lb/A propanil (Stampede) on 20 May and 3 June

Insecticide(s): 0.5 lb/A carbofuran (Furadan) on 16 June

Fungicide(s): 0.17 lb/A propriconazole (Tilt) on 2 July and 17 July

Emergence: 6 May through 12 May depending on treatment

Water Management: Flushed on 21 May; permanent flood on 4 June; drained 17 Aug

Harvest Date: 27 Aug

Harvested Plot Area: 2.3 x 25 ft

Experimental Design: Randomized complete block (4 replications)

Comments: AC94377, an experimental plant growth regulator (PGR), was tested to determine its ability to promote emergence in the semidwarf rice Lemont. Comparisons were made between AC94377 and gibberellic acid (GA), a PGR known to promote mesocotyl and coleoptile elongation in rice.

Stand density results presented in Table 1 show the effects of AC94377 and GA on Lemont emergence. Stand counts were taken 9, 10, 11, 12, 14, and 15 days after planting (DAP), and a final stand count was taken 24 DAP. Both GA and AC94377 promoted emergence.

On the average, 10 ppm GA produced the highest stand density followed by 100 ppm GA and 3000 ppm AC94377. Stand densities averaged 153, 131, and 131 plants/m² for the three seed treatments, respectively. At the beginning, on the ninth and tenth DAP, the 10 and 100 ppm GA treatments were significantly better than the 3000 ppm AC94377 treatment. On the eleventh day there was no significant difference between 100 ppm GA and 3000 ppm AC94377, and from the twelfth through the fourteenth DAP there was no significant difference between the three seed treatments. By final stand establishment, 24 DAP, stand densities were 204, 190, and 170 plants/m² for the 10 ppm GA, 3000 ppm AC94377, and 100 ppm GA seed treatments, respectively. Statistically, there were no significant differences between 10 ppm GA and 3000 ppm AC94377 or 100 ppm GA and 3000 ppm AC94377. Final stand density with 10 ppm GA was significantly higher than final stand density with 100 ppm GA.

The 500, 1000, 1500, and 2000 ppm AC94377 seed treatments also promoted emergence. Final stand densities averaged 153, 150, 152, and 170 plants/m², respectively. Although stand density with the 2000 ppm treatment was consistently, numerically higher than the other treatments, there was no significant difference.

Untreated seed averaged 53 plants/m², and seed treated with blank dust (AC94377 carrier minus the active ingredient) averaged between a low 49 plants/m² for the 500 ppm blank up to a high of 73 plants/m² for the 3000 ppm blank. Stand densities with the untreated seed and seed treated with blank dust were significantly lower than stand densities with the GA and AC94377 seed treatments.

The direct effects of AC94377 and GA on emergence were determined by subtracting appropriate checks. Corresponding AC94377 blanks were subtracted from AC94377 seed treatments and the untreated check was subtracted from GA seed treatments. Direct improvements in stand density from AC94377 and GA are presented in Table 2.

Although GA and AC94377 increased stand density, GA was better in most respects. On average, stand densities were increased 95 and 75 plants/m² by 10 and 100 ppm GA, respectively, compared to 36 to 57 plants/m² with AC94377 seed treatments. Compared to AC94377 seed treatments increases in stand density were significantly higher with 10 ppm GA from 10 to 15 DAP. Only at 10 DAP were increases in stand density significantly higher with 100 ppm GA compared to AC94377 seed treatments. There were no significant differences between AC94377 treatments. By final stand, greatest increases in stand density were 105, 80, 77, and 70 plant/m² with 10 ppm GA, 3000 ppm AC94377, 2000 ppm AC94377

and 100 ppm GA, respectively. These stand densities were not significantly different.

The effects of AC94377 and GA seed treatments on root, mesocotyl and coleoptile length and plant height were determined. The results are presented in Table 3.

Root and coleoptile length were not affected by either PGR. Root lengths ranged from 42 to 60 mm, and coleoptile lengths ranged from 21 to 27 mm.

Mesocotyl length was increased significantly 7 to 10 mm by AC94377 and GA. Mesocotyl lengths were 28, 38, and 38 mm with untreated seed and seed treated with 10 ppm GA and 3000 ppm AC94377, respectively. The differences were significant. Mesocotyl lengths ranged from 35 to 37 mm with the other seed treatments, and although these lengths were longer than the control, statistically there was no significant difference.

Plant height one week after establishing the permanent flood was significantly higher with AC94377. Plant heights were 35, 33, and 32 cm with 3000, 1500, and 2000 ppm AC94377, respectively, compared to 25, 25, and 26 cm with untreated seed, and 100 ppm and 10 ppm GA treated seed, respectively. The differences were significant. The 500 and 1000 ppm AC94377 treatments resulted in intermediate plant heights of 27 and 29 cm, respectively.

The positive effects of GA and AC94377 noted during emergence and seedling establishment prompted an investigation at maturity to determine the influence on crop productivity. Data were collected on disease (sheath blight), plant height, grain moisture, and yield and the yield components, panicle density and single grain weight. The results are summarized in Table 4.

Sheath blight ratings were made to document differences in infestation between the PGR treatments and the treatments receiving no PGR and to provide an explanation for differences noted in the other results from data collected at maturity. Sheath blight ratings were higher in the PGR treatments. The amount of plot area infested with sheath blight averaged 28 to 46% with the PGR treatments. Sheath blight with the untreated check and AC94377 blank treatments averaged 8 to 21%. Canopy density and sheath blight infestation are positively related, and higher stand densities in the PGR treatments (Table 1) explain in part higher sheath blight ratings.

Sheath blight, as in this experiment, generally infests rice noticeably during and following the booting stages. The impact on plant development during the final stages of reproductive growth through maturity can be significant. Plant height and grain yield in general were lower in the PGR treatments. These results were due to sheath blight and not due directly to PGR treatment. Grain moisture was unaffected by PGR treatment or sheath blight. In contrast, panicle density and single grain weight were higher in the PGR treatments. The results on panicle density are due to PGR effects on stand. Higher stands resulted in more panicles. Single grain weight results may be related to sheath blight infestation. Sheath blight caused floret sterility resulting in fewer grains per panicle in the PGR treatments. This can be concluded because the PGR treatments produced higher panicle densities and single grain weights but lower grain yields. The carbohydrate normally available for storage as grain was far in excess of that which the sheath blight-reduced number of

fertile florets could store. In an attempt to accommodate the carbohydrate excess heavier grains resulted.

From the results it appears that two conclusions can be drawn. Both AC94377 and GA applied as a seed treatment can improve stand in Lemont rice. The results with GA were somewhat superior to those with AC94377. With GA, emergence occurred earlier and final stand was slightly higher, and the specific activity of GA is higher than AC94377. On the other hand, AC94377 had residual activity on seedling height and GA did not. Although not borne out by the experimental results with consistency because of sheath blight, increasing stands from approximately 100 plants/m² to approximately 200 plants/m² can increase panicle density and grain yield.

From a production standpoint, cost effective seed treatments which allow quick, even emergence from deep planting depths have several advantages for rice farmers. Planting to soil moisture would prevent flushing. Flushing is a practice involving flooding a rice field and draining. In a dry seeded system at least two flushings are normally required after seeding. One provides moisture for germination and the other, one to two weeks later, softens the hardened soil surface to allow emergence. Emergence is generally uneven following flushing and low stands in certain areas of the field can result. This is related to soil drainage and drying following flushing. All fields are unlevel to some degree and low areas which dry slowly and hold water have poor stands. Also rains following flushing can keep the soil too wet for adequate germination and emergence. With the additional response of seedling elongation noted with AC94377, early flooding can occur. Early flooding is beneficial for weed control and seedling growth and development. Semidwarf rice varieties have short stature during all phases of growth. This is an advantage at maturity and provides lodging resistance. During the seedling stages this is a disadvantage. In a dry seeded system flooding must be delayed until adequate plant height occurs because submergence of seedling rice can result in crop failure. Delaying the flood causes additional weed control problems that cause additional herbicide application for weed control. Semidwarf varieties elongated by residual activity of AC94377 could be flooded early minimizing these problems.

Table 1. General effect of AC94377 and GA seed treatments on emergence and stand of Lemont seeded three inches below the soil surface. Rice Research Station, Crowley, LA. 1987.

Seed treatment	Conc. (ppm)	Days after planting							
		9	10	11	12	14	15	24	Avg.
		-----Stand density (plants/m ²)-----							
CK	-	6def ^{1/}	13c	21d	42d	77cd	94d	99d	53de
AC94377	500	20cd	42b	72c	101c	144b	158bc	153c	103c
	1000	15def	40b	74c	100c	140b	151c	150c	102c
	1500	18cde	41b	70c	99c	140b	155c	152c	100c
	2000	27bc	55b	85bc	111bc	145b	159bc	170bc	115bc
	3000	38b	56b	95bc	133ab	164ab	190ab	190ab	131b
GA	10	51a	86a	122a	158a	188a	209a	204a	153a
	100	53a	80a	107ab	135ab	157ab	178abc	170bc	131b
AC94377 (blank)	500	1f	8c	20d	39d	71d	83d	85d	49e
	1000	3ef	11c	22d	39d	71d	83d	82d	50e
	1500	8def	19c	36d	54d	90cd	102d	111d	64de
	2000	8def	16c	32d	53d	82cd	92d	93d	58de
	3000	6def	20c	42d	66d	106c	113d	109d	73d

^{1/} Differences within columns determined by the Duncan's multiple range test (P < 0.05).

Table 2. Specific effect of AC94377 and GA seed treatments on emergence and stand of Lemont seeded three inches below the soil surface. Rice Research Station, Crowley, LA. 1987.

Seed treatment	Conc. (ppm)	Days after planting							Avg.
		9	10	11	12	14	15	24	
-----Stand density (plants/m ²)-----									
AC94377	500	18bc ^{1/}	33b	52bc	62bc	73ab	75b	68bc	54bc
	1000	12bc	29b	51bc	62bc	69b	69b	68bc	51bc
	1500	11bc	23b	34c	45c	50b	53b	41c	36c
	2000	19bc	39b	53bc	58bc	63b	67b	77ab	53bc
	3000	32ab	36b	53bc	67bc	58b	77b	80ab	57bc
GA	10	46a	73a	101a	116a	111a	115a	105a	95a
	100	47a	67a	85ab	93ab	80ab	84ab	70abc	75ab

^{1/} Differences within columns determined by the Duncan's multiple range test (P < 0.05).

Table 3. Effect of AC94377 and GA seed treatments on elongation of various plant parts and plant height of Lemont, 43 days after planting. Rice Research Station, Crowley, LA. 1987.

Seed treatment	Conc. (ppm)	Root length (mm)	Mesocotyl length (mm)	Coleoptile length (mm)	Plant height (cm)
CK	-	60	28b ^{1/}	26	25d
AC94377	500	50	37ab	27	27cd
	1000	65	37ab	26	29bcd
	1500	55	35ab	22	33ab
	2000	42	36ab	24	32abc
	3000	59	38a	21	35a
GA	10	50	38a	26	26d
	100	58	36ab	26	25d

^{1/} Differences within columns determined by the Duncan's multiple range test (P < 0.05).

Table 4. General effect of AC94377 and GA seed treatments on mature plant agronomic factors of Lemont seeded three inches below the soil surface. Rice Research Station, Crowley, LA. 1987.

Seed treatment	Conc. (ppm)	Sheath blight (%)	Plant height (cm)	Grain		Panicle density (panicles/m ²)	Single grain wt. (mg)
				moisture (%)	yield (lb/A)		
CK	-	12cd ^{1/}	86a-d	20.2	7540ab	331bc	36f
AC94377	500	28a-d	84bcd	19.6	7400abc	371ab	37def
	1000	35abc	83d	20.2	6810cd	402a	38cd
	1500	46a	83cd	20.1	6780cd	361abc	39bc
	2000	31a-d	83cd	19.6	6900bcd	368ab	40b
	3000	48a	84a-d	20.3	6520d	353abc	41a
GA	10	42ab	83d	19.3	6850cd	404a	38cde
	100	46a	86a-d	20.0	7540ab	382ab	38cde
AC94377 (blank)	500	10cd	87a	19.9	7680a	299c	36f
	1000	8d	86abc	20.1	7900a	331bc	36f
	1500	21a-d	86a-d	19.9	7340abc	326bc	36f
	2000	15cd	85a-d	19.5	7640a	315bc	37def
	3000	19cd	86ab	19.8	7390abc	329bc	37ef

^{1/} Differences within columns determined by the Duncan's multiple range test (P < 0.05).

PLANT GROWTH REGULATOR RESEARCH IN RICE

R. Dunand, M. Brunson, R. Dilly, Jr., and G. Meche

Experiment: Plant Growth Regulators, Soil Fertility and Rice Biomass in
Crawfish Production

Location: Rice Research Station, South Unit

Soil Type/Test Results: Crowley silt loam/none

Variety/Seeding Rate: Mars/100 lb/A

Planting Date: Aug 26, 1987

Row Spacing: 7 in

Fertilizer: See treatments

Plot Size: 8.75 x 31 ft

Treated Area: center 8.75 x 31 ft

Treatments:

Sampling dates: Oct 21, Dec 3, Jan 15

Soil fertility: 0 and 50 lb/A as urea (45% N) on Sept 22

Plant growth regulators:

Application time - 3-4 leaf stage on Sept 25
late tiller on Oct 22

Type & application rate - mefluidide (Embark), 0.25 lb/A
gibberellin (Pro-Gib), 4.3 lb/A

Sprayer: CO₂-driven, hand-held, 32 psi, 15 GPA, 80015 nozzles

Pertinent Rainfall: No rain within 24 hours of applications

Herbicide(s): 2 and 3 lb/A propanil (Stampede) on Sept 18 and 22

Insecticide(s): None

Fungicide(s): None

Emergence: Sept 3

Water management: Flushed on Sept 2 and Oct 5; Permanent flood on
Oct 23, 8-10 in flood depth

Harvest Date: see sampling dates (Treatments)

Harvested Plot Area: 1 row (18 ft²)

Experimental Design: Randomized complete block (4 replications), split plot in space and time (space whole plot = soil fertility, time whole plot = sampling date, subplot = plant growth regulator type and time of application), factorial arrangement of subplots

Comments: Plant growth regulators and nitrogen fertilizer were tested for their effects on rice grown as forage for crawfish. The results are presented in Table 1.

Rice shoots sampled at 6-wk intervals after flooding showed stem density decreased and shoot biomass increased with time. A single application of 50 lb N/A increased both stem density and shoot biomass. Stem density was increased by mefluidide compared to gibberellin while shoot biomass was decreased by mefluidide compared to gibberellin. Application of the plant growth regulators 4 weeks after planting increased stem density slightly and decreased shoot biomass significantly. Mefluidide and gibberellin applied 8 weeks after planting decreased stem density and shoot biomass slightly.

Table 1. The effect of plant growth regulators and nitrogen fertilizer on rice grown as forage for crawfish. Rice Research Station, Crowley, LA. 1987.

Sampling time time ^{1/} (WAP)	Nitrogen rate (lb/A)	Plant growth regulator		Stem density (stems/ft ²)	Shoot dry weight (lb/A)
		Type	Application time (WAP)		
8				28a ^{2/}	380b
14				15b	555a
20				13b	600a
	0			18b	465b
	50			20a	560a
		Embark		20a	475b
		Gibberellin		18b	550a
			-	19ab	555a
			4	20a	475b
			8	18b	500ab

^{1/} Weeks after planting.

^{2/} Differences within columns determined by the Duncan's multiple range test (P<.05).

SUMMARY

Plant growth regulators reduced plant height. Plant height was reduced 2 to 3 inches by mefluidide and XE1019. In addition some mefluidide treatments increased yields 200 lb/A while other treatments decreased yields 2000 lb/A. Grain yields were decreased as much as 400 lb/A by XE1019. Grain moisture was increased up to 2% by XE1019.

Plant growth regulators limited red rice seed production. Red rice seed production was reduced by limiting panicle exertion with mefluidide and UBI-1444. Red rice seedhead suppression was obtained with 0.5 lb/A mefluidide applied during booting, heading and grain filling and 1.5 lb/A UBI-1444 applied during heading and grain filling of the commercial variety. Grain yields were decreased proportionate to reduced red rice seed production with mefluidide and only when UBI-1444 was applied at heading. Red rice infestation was low (1 plant/m²) and grain moisture, grade and milling yield were unaffected by PGR treatments. Fenoxaprop (0.15 and 0.2 lb ai/A) applied singly and sequentially during the seedling stage of rice and late tillering stage of red rice decreased plant height by 2 to 4 inches, decreased stand by 40 to 70%, decreased panicle density by 30 to 80% and decreased seed production by 30 to 90% for red rice. The negative effects of fenoxaprop on red rice were paralleled by negative effects on rice resulting in yield decreases from 500 to 4300 lb/A. Fenoxaprop was most active in combination with crop oil concentrate. The impact of a seedling stage application of fenoxaprop on rice yield was offset by a high seeding rate of 200 lb/A.

Plant growth regulators improved emergence and seedling vigor in deep, drill-seeded rice. Gibberellin and AC94377 seed treatments hastened semidwarf rice emergence by 2 days and increased final stand by 50% at 10 and 2000 ppm, respectively. There was no effect on mature plant height, and panicle density was increased 20%. Seedling stage applications of gibberellin and AC94377 seed treatment increased seedling height 40 to 60%.

Plant growth regulators affected rice vegetative development for crawfish forage. Rice biomass increased steadily from 6 to 12 to 18 weeks after flood up and stem density decreased during the same period. Nitrogen fertilizer increased biomass and stem density by 20%. Mefluidide decreased biomass and increased stem density compared to gibberellin. Plant growth regulators applied 4 weeks after planting decreased biomass and stem density compared to no PGR application and PGR application 8 weeks after planting.

CONCLUSIONS

Plant growth regulators can alter plant growth to reduce plant height and increase vegetative development in commercial rice and minimize red rice seed production. Modifications in stem development by plant growth regulators are responsible.

Plant growth regulators applied during vegetative stages of growth reduce internode elongation during the early stages of stem development reducing plant height. The plant growth regulators mefluidide and XE-1019 reduce plant stature providing the potential to minimize lodging.

Plant growth regulators applied during the early stages of reproductive development reduce internode elongation associated with panicle exertion. Panicle suppression reduces seed production since rice does not pollinate well unless the panicle is fully exerted. The differential in maturities between very early season commercial varieties and red rice can be used in conjunction with plant growth regulators for seedhead suppression to minimize weed seed production. Mefluidide applied during booting and grain filling of Tebonnet and UBI-1444 applied during grain filling and maturation can effectively limit the production of red rice seed without affecting rice grain production. Fenoxaprop can decrease red rice growth causing less reproductive development and seed production. Rice yields are adversely affected by fenoxaprop.

Plant growth regulators which enhance elongation of plant parts following germination and emergence offer benefits for semi-dwarf rice production. Semidwarf cultivars responsive to PGRs can be planted deep into soil moisture eliminating flushing. Earlier emergence and taller seedlings from PGR treatments can shorten the interval between planting and permanent flood improving weed control and promoting seedling development.

Endogenous hormone changes resulting from incomplete panicle development caused by seedhead suppressants releases dormant buds located at nodes along stems resulting in secondary stem development and increased vegetative development. The potential to increase rice biomass in a crawfish production system through increased stem production and leaf elongation with plant growth regulators exists.

RICE WEED CONTROL STUDIES^{1/}

John B. Baker and James W. Shrefler

INTRODUCTION

Although excellent herbicides are currently available for controlling weeds in rice fields, no one herbicide will control all weeds, and there are weeds for which there are no satisfactory control procedures. Therefore it is important that a continued effort be made to evaluate new herbicides to determine their potential for use in rice to either supplement or supplant current herbicides. Since research in other areas of Louisiana and in other states concentrates on dry-seeded rice, this work concentrates on water-seeded rice. These tests provide information on how new herbicides might be incorporated into the cultural practices and herbicide treatments already being used in Southwest Louisiana.

MATERIALS AND METHODS

These experiments were conducted at the main unit of the Rice Research Station in a field which is managed to maintain heavy infestations of many of the weeds found in rice fields. The soil type is Crowley silt loam.

Seedbed preparation consisted of disking in late winter, and springtooth harrowing and cultimulching as needed for the final seedbed preparation. Prior to planting, 400 lb/A of 20-10-10 fertilizer was applied and worked into the seedbed. Tests which were water seeded were drained to optimize stand establishment. Drill-seeded tests were seeded with an 11-runner grain drill and flush irrigated as needed to establish a stand.

Specific details of water management and other information on each test are presented as footnotes to the tables in the results and discussion section of this report.

Yield data were collected in the advanced herbicide comparison tests by combine harvesting the entire 7' x 62' plot, weighing the grain, measuring the moisture content and converting the data to 12% moisture yields.

All tests were randomized complete block design tests with four replicates. Yield data were subjected to an analysis of variance, and where appropriate, mean comparisons were made using the Duncan's multiple range technique or individual mean comparisons.

^{1/} This research supported in part by funds provided by rice producers through the Louisiana Rice Research Board.

Rice tolerance and weed control ratings were taken prior to flooding and/or at maturity using the following scales:

Rice tolerance:

1. - very severe injury with >90% stand reduction
2. - severe injury with 70-90% stand reduction
3. - moderate injury, primarily leaf burning and stunting
4. - slight injury, primarily leaf burning
5. - no injury

Weed control:

1. - poor, <10% control
2. - slight, 10-30% control
3. - moderate, 30-70% control
4. - good, 70-90% control
5. - excellent, >90% control

Information on chemicals tested is presented in Table 7.

RESULTS AND DISCUSSION

Advanced Herbicide Comparison Tests

Water seeded with a prolonged drainage period. Treatments, ratings, and yields are presented in Table 1. In this test the postseeding drainage period was 4 weeks long. This is much longer than desirable because it increases weed pressure significantly and leads to the loss of much of the preplant nitrogen when the permanent flood is applied. This procedure was followed to permit testing of late postemergence treatments. The herbicide standards for this test would be the recommended usages of propanil and its combinations with molinate and thiobencarb.

Under this water management regime, and with frequent showers, a single application of propanil failed to give excellent control of the weeds rated, and at harvest both indian jointvetch and amazon sprangletop were present in the plots. Excellent weed control ratings at harvest were obtained by the following treatments: two applications of propanil a week apart, tank mixtures of propanil with molinate or thiobencarb, a sequential combination of thiobencarb preplant and propanil postemergence, and a sequential mixture of propanil followed by triclopyr.

BAS-514 generally gave excellent control of hemp sesbania, but at the rate tested, it was most effective when applied prior to flooding. It was found to be ineffective on amazon sprangletop and rice flatsedge. As a preplant treatment in combination with molinate or thiobencarb, only indian jointvetch was not adequately controlled. These combinations were superior to any of these herbicides used alone.

Bromoxynil was evaluated as a tank mixture with propanil or with fenoxaprop. The combination with propanil gave excellent broadleaf control, but control of grasses was less than with propanil alone. The combination with fenoxaprop gave excellent control of all rated weeds except indian jointvetch.

Triclopyr was evaluated in combinations with propanil or fenoxaprop. Broadleaf control was excellent in all cases, but only in the case of a sequential mixture with propanil was grass control excellent, in fact there may have been an antagonistic interaction between triclopyr and fenoxaprop.

Table 1. Advanced herbicide comparison test. Water-seeded followed by a prolonged drainage period before flooding.^{1/} Rice Research Station, Crowley, La. 1987.

Herbicide	Rate (lb ai/A)	Time of ^{2/} treatment	Rice tolerance	6/19 Ratings ^{3/}			9/4 Ratings ^{3/}			Yield ^{5/} (100 lb/A)
				Gr	Weed Control ^{4/}		Weed Control ^{4/}			
					BI	CI	SE	AI	EC	
acifluorfen	.125	MS	5.0	1.0	1.0	1.0	1.0	1.0	1.0	11.7 g
molinate / acifluorfen	4.0 / .125	PPI / MS	4.75	5.0	2.0	5.0	1.0	1.0	-	22.1 def
molinate + BAS-514	4.0 + .25	PPI	4.0	4.75	5.0	5.0	5.0	4.0	5.0	23.1 cde
molinate / propanil	4.0 / 3.0	PPI / Po	4.25	5.0	4.75	5.0	5.0	3.0	5.0	23.3 cde
thiobencarb /acifluorfen	4.0 / .125	PPS / MS	4.75	2.75	1.5	3.0	2.0	1.0	-	21.3 ef
thiobencarb + BAS-514	4.0 + .25	PPS	4.25	5.0	4.25	4.75	5.0	4.0	5.0	24.9 bcde
thiobencarb / propanil	4.0 / 3.0	PPS / Po	4.5	5.0	5.0	5.0	5.0	5.0	5.0	25.2 bcde
BAS-514	.25	PPI	5.0	5.0	5.0	2.0	5.0	3.0	2.0	20.8 ef
BAS-514	.25	PPS	4.5	5.0	4.0	2.5	5.0	2.0	2.0	27.3 abc
BAS-514	.25	Po	-	-	-	-	3.0	2.0	3.0	13.1 g
BAS-514	.25	PF	-	-	-	-	5.0	5.0	5.0	11.2 g
propanil	3.0	Po	5.0	4.0	4.75	3.0	5.0	4.0	5.0	26.3 abcd
propanil / propanil	3.0 / 3.0	Po / PF	5.0	4.5	4.75	3.0	5.0	5.0	5.0	30.1 a
propanil + thiobencarb	3.0 + 3.0	Po	5.0	5.0	5.0	4.25	5.0	5.0	5.0	29.3 ab
propanil + molinate	3.0 + 3.0	Po	5.0	5.0	5.0	4.25	5.0	5.0	5.0	29.1 ab
propanil + bromoxynil	3.0 + .375	Po	4.5	3.25	5.0	2.0	5.0	5.0	1.0	24.7 bcde
propanil + triclopyr	3.0 + .188	Po	4.75	3.5	5.0	3.75	5.0	5.0	4.0	24.1 cde
propanil + triclopyr	3.0 + .281	PF	-	-	-	-	5.0	5.0	4.0	23.3 cde
propanil / triclopyr	3.0 / .281	Po / PF	4.75	3.5	5.0	3.0	5.0	5.0	5.0	27.0 abc
propanil / fenoxaprop	3.0 / .15	Po / PF	4.75	5.0	4.75	2.25	5.0	3.0	5.0	24.2 cde
fenoxaprop + triclopyr	.15 + .281	PF	-	-	-	-	5.0	5.0	4.0	21.1 ef
fenoxaprop + bromoxynil	.15 + .375	PF	-	-	-	-	5.0	3.0	5.0	11.1 g
triclopyr	.281	PF	-	-	-	-	3.0	5.0	1.0	17.7 f

1/ Schedule of events: 5/22 - water-seeded with presprouted Lemont (.100 lb dry seed / A); 6/8 - Po treatments; 6/15 - PF treatments; 6/19 - flooded; 7/7 - MS treatment.

2/ PPI - preplant incorporated; PPS - preplant nonincorporated; Po - postemergence; PF - pre-flood; MS - midseason.

3/ Weed control and rice tolerance rating scales are presented in the materials and methods.

4/ Weed identification is presented in Table 6.

5/ Means followed by the same letter are not significantly different at alpha = .05.

Fenoxaprop was evaluated in combination with propanil, triclopyr or bromoxynil. The lack of excellent grass control with the mixture with triclopyr suggest an antagonistic interaction.

In general, the yield reflected the level of weed control. Deviations may be due to stunting of weeds or rice which does not show up in ratings. There was an exceptionally heavy infestation of rice flatsedge, and treatments which gave poor control of this weed were seriously affected. This may account for the low yields of the postemergence treatments with BAS-514 and the mixture of fenoxaprop and bromoxynil.

Water seeded with brief drainage period. Treatments and yields are presented in Table 2. This test was conducted primarily to evaluate the effect on yield of preplant treatments in a water-seeded system using a brief, postseeding drainage period. Under this system weed pressure is minimized and efficiency of preplant nitrogen utilization is optimized. Thiobencarb and molinate are effective in reducing red rice problems in such a system, but other weeds are sometimes troublesome. Previous studies have indicated that mixture of BAS-514 with these materials would broaden the spectrum of weed control, and it was included in this test, alone and in mixtures. Because the presence of hemp sesbania causes harvest problems, those treatments which are weak on hemp sesbania were treated with acifluorfen at midseason. There was no significant difference between the various herbicide treatments, but only the preplant surface treatments with thiobencarb or the mixture of thiobencarb and BAS-514 and the very early postemergence treatment with BAS-514 yielded significantly higher than the untreated check.

Herbicide Screening

Drill seeded. Treatments and ratings are presented in Table 3. SC-9244 was evaluated as a preemergence treatment or a delayed preemergence treatment. Crop tolerance appeared to be the same with the two different times of application, but weed control seemed to be slightly better in the delayed preemergence treatments. There was only enough herbicide to test two rates as delay preemergence treatments, and crop tolerance at the highest rate was rated only in the case of preemergence treatments. At this rate of application there may be a crop tolerance problem.

SC-0735 was evaluated as a delayed preemergence treatment and as a pre flood (late postemergence) treatment. Weed control was best with the delayed preemergence treatments, although there was too much crop injury at the highest rate.

Arrosolo, a formulated mixture of propanil and molinate, performed better than the tank mixtures with propanil and was about the same as propanil followed by propanil.

Water seeded with brief drainage. Since many farmers use a brief postseeding drainage period in water-seeded rice as a part of their red rice control system, it is important to evaluate new herbicides in such a system. Treatments and ratings are presented in Table 4. SC-0735 was evaluated at various rates as a preplant surface treatment, as a postflood postemergence treatment, and as a sequential treatment with preplant surface followed by postemergence postflood treatment. Rice tolerance was satisfactory in all cases. Preplant surface treatments gave good grass and rice flatsedge control but failed to control ducksalad or purple ammannia. Postemergence postflood treatment with SC-0735 was effective at the higher rate on aquatics but weak on grasses. A sequential application of SC-0735 followed by SC-0735 gave good

Table 2. Advanced herbicide comparison test. Water seeded with a brief postseeding drainage period.^{1/} Rice Research Station, Crowley, La. 1987.

Herbicide	Rate (lb ai/A)	Time of ^{2/} Treatment	Yield ^{3/} (100 lb/A)
untreated ^{4/}	-	-	37.4 b
molinate ^{4/}	4.0	PPI	42.1 ab
molinate + BAS 514	4.0 + .25	PPI	40.3 ab
thiobencarb ^{4/}	4.0	PPS	46.0 a
thiobencarb + BAS-514	4.0 + .25	PPS	45.1 a
BAS-514	.25	PPI	41.3 ab
BAS-514	.25	PPS	41.7 ab
BAS-514	.25	VEPo	45.7 a

^{1/} Schedule of events: 5/11 - preplant fertilization (80-40-40), final seedbed preparation and levee construction. 5/12 - PPI and PPS treats applied and seed placed in soak. 5/13 - Seedbed flooded and seed removed from soak. 5/14 - Seeded with 125 lb/A of Lemont (equivalent dry weight) and drained. 5/19 - Applied VEPo and reflooded. 6/16 - Midseason acifluorfen application.

^{2/} PPI - preplant incorporated; PPS - preplant nonincorporated; VEPo - very early postemergence.

^{3/} Value followed by the same letters are not significantly different (alpha = 0.05).

^{4/} Oversprayed at midseason with .125 lb ai/A acifluorfen for hemp sesbania.

Table 3. Drill-seeded herbicide screening test.^{1/} Rice Research Station, Crowley, La. 1987.

Herbicide	Rate (lb ai/A)	Time of ^{3/} treatment	Rice tolerance	6/19 Ratings ^{2/}			7/23 Ratings ^{2/}			
				Weed Control ^{4/}	Gr	Bl	SE	AI	EC	LP
SC-9244	.125	Pre	5.0	4.25	2.5	3.5	3.25	2.0	4.25	5.0
SC-9244	.250	Pre	4.5	4.5	4.0	5.0	5.0	2.5	4.5	5.0
SC-9244	.500	Pre	3.25	5.0	4.75	5.0	5.0	4.25	4.75	5.0
SC-9244	.125	DelPre	5.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0
SC-9244	.250	DelPre	4.5	5.0	4.75	5.0	5.0	4.0	5.0	5.0
Arrosolo	3.0 + 3.0	Po	4.75	5.0	5.0	5.0	5.0	4.75	5.0	5.0
SC-0735	1/32	DelPre	4.5	4.5	4.25	5.0	4.25	3.75	4.0	5.0
SC-0735	1/16	DelPre	4.25	5.0	4.75	5.0	4.25	4.0	5.0	5.0
SC-0735	1/8	DelPre	2.25	5.0	5.0	5.0	5.0	4.75	5.0	5.0
SC-0735 + TW20	1/64	PF	-	-	-	-	3.5	1.25	1.75	4.0
SC-0735 + TW20	1/32	PF	-	-	-	-	4.25	2.25	1.75	2.0
SC-0735 + TW20	.04	PF	-	-	-	-	5.0	3.0	1.75	1.0
SC-0735 + TW20	1/16	PF	-	-	-	-	5.0	3.75	2.25	2.5
thiobencarb	3.0	Pre	4.5	3.0	1.5	3.75	1.0	1.0	3.25	4.0
thiobencarb	3.0	DelPre	5.0	4.0	3.0	4.0	3.75	1.5	4.75	5.0
BAS-514	.250	Po	5.0	5.0	4.25	3.0	5.0	1.75	5.0	2.75
propanil	3.0	Po	4.75	3.25	5.0	3.5	5.0	3.0	3.0	5.0
propanil / propanil	3.0 / 3.0	Po / PF	4.5	4.5	5.0	4.0	5.0	5.0	4.25	5.0
propanil + thiobencarb	3.0 + 3.0	Po	4.5	4.75	5.0	3.75	5.0	4.25	4.25	5.0
propanil + molinate	3.0 + 3.0	Po	4.75	4.5	5.0	3.75	5.0	3.75	3.75	5.0
untreated	-	-	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

^{1/} Schedule of events: 5/19 - Preplant fertilization (100-50-50), final seedbed prepared, Lemont seeded (ca. 100 lb/A); 5/21 - Pre treatments; 5/22 - Flushed; 5/27 - DelPre treatments; 5/30 - Emergence; 6/8 - Po treatments; 6/15 - PF treatments; 6/19 - Flooded.

^{2/} See materials and methods for description of rating scales.

^{3/} Pre - preemergence. DelPre - delayed preemergence. Po - postemergence (2 - 5 leaf weeds); PF - preflood (late postemergence).

^{4/} See Table 6 for weed identification.

Table 4. Water-seeded herbicide screening.^{1/} Rice Research Station, Crowley, La. 1987.

Herbicide	Rate (lb ai/A)	Time of ^{2/} treatment	6/22 Ratings ^{3/}				7/23 Ratings ^{3/}			
			Rice tolerance	Weed Control ^{4/}		CI	Weed Control ^{4/}		LP	AC
				HL	Gr		EC	LP		
untreated	-	-	4.5	1.0	3.0	4.0	2.25	1.5	2.25	
molinate	3	PPI	4.25	2.0	5.0	5.0	5.0	5.0	3.0	
thiobencarb	3	PPS	4.75	4.75	5.0	5.0	5.0	5.0	2.5	
BAS-514	.25	PPI	4.5	1.0	4.0	4.0	5.0	2.25	3.0	
BAS-514	.25	PPS	4.25	1.0	4.25	5.0	4.0	2.75	2.25	
molinate + BAS-514	3 + .25	PPI	4.5	1.5	4.5	5.0	4.0	4.0	2.0	
thiobencarb + BAS-514	3 + .25	PPS	4.25	3.75	5.0	5.0	5.0	5.0	4.0	
SC-0735	.06125	PPS	4.25	1.0	5.0	5.0	5.0	4.25	1.75	
SC-0735	.091875	PPS	4.5	1.0	5.0	5.0	4.5	4.25	2.75	
SC-0735	.125	PPS	5.0	1.0	5.0	5.0	4.5	3.75	2.75	
SC-0735	.04	PoF	4.5	1.0	1.5	5.0	1.25	1.25	2.0	
SC-0735 / SC0735	.04 / .04	PPS / PoF	4.25	1.0	4.0	5.0	2.75	2.75	2.0	
SC-0735	.08	PoF	5.0	4.0	2.75	5.0	1.75	1.5	4.0	
SC-0735 / SC0735	.08 / .08	PPS / PoF	5.0	4.0	5.0	5.0	5.0	4.75	5.0	
SC-0735 + molinate	.04 + 3	PoF	4.33	1.0	5.0	5.0	5.0	5.0	1.0	
SC-0735 + molinate	.08 + 3	PoF	5.0	3.75	5.0	5.0	5.0	5.0	3.0	
molinate	3	PoF	4.5	1.0	5.0	5.0	5.0	5.0	3.0	
molinate + bensulfuron- methyl	3 + .0375	PoF	4.5	5.0	5.0	5.0	5.0	5.0	5.0	

- ^{1/} Schedule of events: 5/11 - fertilizer applied (80-40-40) and final seedbed prepared; 5/12 - seed put in
soak and preplant treatments applied; 5/13 - seed out of soak flooded for seeding; 5/14 - Lemont
seeded (ca. 125 lb/A dry seed equivalent) and drained; 5/19 - flooded; 5/26 - postflood treatments.
^{2/} PPI - preplant incorporated; PPS - preplant nonincorporated; PoF - postflood.
^{3/} See materials and methods for description of rating scales.
^{4/} See Table 6 for weed identification.

broad spectrum weed control at the higher rate. In combination with molinate, excellent control of grasses and rice flatsedge was achieved, but aquatics were not controlled.

Bensulfuron-methyl, used simultaneously with molinate as a postemergence postflood treatment, gave excellent control of ducksalad and purple ammannia - two weeds not controlled by molinate alone. Yield estimates, based on the grain weight from a one square meter sample per plot, indicated no significant difference between the molinate treated plots (41.9 100 lb/A) and those treated with both molinate and bensulfuron-methyl (44.1 100 lb/A).

Water seeded with prolonged postseeding drainage. In order to obtain better evaluations of herbicide efficacy on nongramineous weeds this test was over sprayed with fenoxaprop for control of gramineous weeds and ratings were made without the competitive effect that grasses have on other weeds. Treatments and ratings are presented in Table 5. RE-40855 was evaluated as a preplant surface treatment and as a early postemergence treatment. At the rates which gave weed control it was too injurious to rice. This compound was very active on rice flatsedge but less active on broadleaves.

Bromoxynil was evaluated alone and in mixture with bentazon. When used alone it controlled only hemp sesbania, but tank mixtures with bentazon were active on hemp sesbania and rice flatsedge. This effect was simply additive since bentazon alone was very effective on rice flatsedge but weak on broadleaves.

Triclopyr was very effective at the higher rate on indian jointvetch but weak on hemp sesbania and rice flatsedge. When tank mixed with bentazon there was a much broader spectrum with good control of all rated weeds at the higher rate.

M60, which is a formulated mixture of bentazon and a trace of MCPA, was no more active than bentazon alone.

BAS-514 was excellent on hemp sesbania, weak on indian jointvetch and very weak on rice flatsedge. In combination with bentazon the control of rice flatsedge was improved, and in combination with molinate or 2,4-D the control of indian jointvetch was improved.

Propanil gave excellent control of hemp sesbania and rice flatsedge but was weak on indian jointvetch. A second application of propanil controlled the indian jointvetch providing the best level of control of all weeds of any treatment.

Postflood herbicide evaluations. Granular formulations of triclopyr, alone and in combination with tridiphan or molinate, were evaluated as postflood treatments in water-seeded rice. Presprouted Lemont was water seeded and drained for five days. Six days after reflooding, the granular formulations were applied to 5.1 sq ft enclosures. The only treatments which provided any weed control were those which contained molinate. Neither triclopyr nor tridiphan were active at rates from .25 to .5 lb ai/A.

Bensulfuron-methyl was evaluated as a postflood treatment in water-seeded plots which had been treated with molinate at 3 lb ai/A preplant postflood. This preplant treatment controlled grasses and sedges but permitted establishment of a heavy infestation of ducksalad and purple ammannia, as well as, lighter infestations of indian jointvetch, hemp sesbania, gooseweed, eclipta and texasweed. In the plots treated with bensulfuron-methyl, the indian jointvetch and hemp sesbania seemed to be unaffected. Ducksalad showed injury levels ranging from slight at 0.3 oz ai/A to severe at 1.2 oz ai/A. Some purple ammannia survived at the lowest rate, but treated plots did not contain texasweed, eclipta, nor gooseweed.

Table 5. Evaluation of herbicides in water-seeded rice which was oversprayed with 0.15 lb ai/A fenoxaprop. 1/
Rice Research Station, Crowley, La. 1987.

Herbicide	Rate (lb ai/A)	Time of ^{2/} treatment	Rice tolerance	6/19 Ratings ^{3/}			7/23 Ratings ^{3/}		
				SE	Weed Control ^{4/} BI	CI	SE	Weed Control ^{4/} AI	CI
aciflurofen	.125	PF	5.0	2.0	2.0	1.0	4.75	3.0	1.0
RE-40855	.25	PPS	2.0	4.0	4.0	5.0	2.25	1.0	5.0
RE-40855	.5	PPS	1.25	5.0	5.0	5.0	4.25	3.0	5.0
RE-40855	1.0	PPS	1.0	5.0	5.0	5.0	4.25	1.25	5.0
RE-40855	.25	EPO	4.25	2.5	4.0	5.0	2.75	2.0	5.0
RE-40885	.50	EPO	2.75	2.5	4.0	5.0	3.75	2.0	5.0
RE-40855	1.0	EPO	2.0	5.0	4.0	5.0	5.0	1.25	5.0
bromoxynil	.25	Po	5.0	2.5	4.0	1.0	4.75	1.0	1.0
bromoxynil	.5	Po	5.0	5.0	4.0	1.0	5.0	3.0	1.0
bentazon + bromoxynil	.5 + .25	Po	4.75	5.0	4.0	5.0	5.0	2.0	5.0
bentazon + bromoxynil	.5 + .5	Po	4.75	4.0	4.0	5.0	5.0	1.0	5.0
bentazon + bromoxynil	.75 + .25	Po	4.75	5.0	5.0	5.0	5.0	2.75	5.0
bentazon + bromoxynil	.75 + .5	Po	4.5	5.0	5.0	5.0	5.0	2.5	5.0
bentazon	.5	Po	4.75	1.0	2.5	5.0	2.0	2.0	5.0
bentazon	.75	Po	4.5	2.5	2.5	5.0	3.0	1.0	5.0
triclopyr	.188	Po	4.0	2.0	5.0	2.0	2.0	3.5	1.0
triclopyr	.281	Po	4.5	1.0	5.0	1.0	3.25	5.0	1.25
bentazon + triclopyr	.5 + .281	Po	4.5	4.25	5.0	5.0	3.75	5.0	4.5
bentazon + triclopyr	.75 + .281	Po	4.25	5.0	5.0	5.0	4.75	4.5	5.0
M60	.575	Po	5.0	1.0	3.0	5.0	2.0	1.0	5.0
M60	.8625	Po	4.75	2.0	-	5.0	4.0	1.0	5.0
BAS-514	.25	Po	4.75	4.75	5.0	1.0	5.0	3.0	1.25
BAS-514 + bentazon	.25 + .75	Po	4.5	5.0	5.0	5.0	5.0	3.5	5.0
BAS-514 + molinate	.25 + 3.0	Po	5.0	5.0	5.0	3.0	5.0	4.5	1.5
BAS-514 + thibencarb	.25 + 3.0	Po	4.75	5.0	5.0	2.0	5.0	3.75	1.5
BAS-514 / 2,4-D	.25 / 1.0	Po / PF	4.75	3.0	3.0	1.0	5.0	5.0	1.0
propanil	3.0	Po	4.75	5.0	5.0	5.0	5.0	2.5	5.0
propanil / propanil	3.0 / 3.0	Po / PF	4.5	5.0	5.0	5.0	5.0	5.0	5.0
2,4-D	1.0	MS	-	-	-	-	5.0	5.0	1.25
untreated	-	-	5.0	1.0	1.0	1.0	1.0	1.0	1.0

1/ Schedule of events: 5/14 - water-seeded with presprouted Lemont (125 lb dry seed / A), drained following seeding; 5/21 - flushed; 6/2 - Po treatments applied (19 days after seeding); 6/9 - PF treatments applied; 6/10 - oversprayed with fenoxaprop; 6/15 - flooded; 7/1 - MS treatments applied.

2/ PPS - preplant not incorporated, EPO - early postemergence, Po - postemergence, PF - pre-flood postemergence, MS - midseason.

3/ See materials and methods for description of rating scales.

4/ See Table 6 for weed identification.

SUMMARY

Advanced herbicide evaluations in water-seeded rice with prolonged drainage demonstrated that excellent weed control was obtained with several sequential or tank mixtures with propanil: thiobencarb PPS / propanil Post; propanil + thiobencarb Post; propanil + molinate Post; propanil Post / triclopyr LatePost; and propanil Post / propanil LatePost. Five mixtures were rated as weak only on indian jointvetch: molinate + BAS-514 PPI; thiobencarb + BAS-514 PPS; molinate PPI / propanil Post; propanil Post / fenoxaprop - ethyl LatePost; and fenoxaprop + bromoxynil LatePost. Both molinate PPI and thiobencarb PPS, alone and in combination with BAS-514 provided excellent control of weeds in a water-seeded system with brief a drainage period. The best mixtures to safely control weeds not controlled by fenoxaprop - ethyl are: propanil / propanil, bentazon + triclopyr, BAS-514 + bentazon, and bentazon + bromoxynil. Experimental compounds SC-0735 and SC-9244 showed promise as delayed preemergence treatments in drill-seeded rice. In water-seeded rice with brief drainage, postflood treatments with SC-0735 + molinate and molinate + bensulfuron-methyl and a split application of SC-0735 PPS/Postflood gave best control of grasses, annual sedges and aquatics.

Table 6. Weeds rated in herbicide tests conducted at the Rice Research Station, Crowley, LA. 1987.

Abbreviation used in tables	Common name	Scientific name
AC	purple ammannia	<u>Ammannia</u> <u>coccinea</u>
AI	Indian jointvetch	<u>Aeschynomene</u> <u>indica</u>
BI	broadleaf weeds	
CI	rice flatsedge	<u>Cyperus</u> <u>iria</u>
CP	texasweed	<u>Caperonia</u> <u>palustris</u>
EA	eclipta	<u>Eclipta</u> <u>alba</u>
EC	junglerice	<u>Echinochloa</u> <u>colona</u>
Gr	annual grasses	
HL	ducksalad	<u>Heteranthera</u> <u>limosa</u>
LP	Amazon sprangletop	<u>Leptochloa</u> <u>panicoides</u>
SE	hemp sesbania	<u>Sesbania</u> <u>exaltata</u>
SZ	gooseweed	<u>Sphenoclea</u> <u>zeylandica</u>

Table 7. Herbicides tested in studies at the Rice Research Station, Crowley, LA. 1987.

Name or code no. used in report	Chemical nature of active ingredient	Manufacturer
Arrosolo	1:1 mixture of molinate and propanil	Stauffer
acifluorfen-sodium	5-[2-chloro-4-(trifluoromethyl)phenoxy]- 2-nitrobenzoic acid, sodium salt	Rohm & Haas
BAS-514	3,7-dichloro-8-quinolinecarboxylic acid	BASF
bensulfuron-methyl	2-[[[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl] amino]sulfonyl]methyl]benzoic acid, methyl ester	DuPont
bentazon	3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin- 4(3H)-one 2,2-dioxide	BASF
bromoxynil	3,5-dibromo-4-hydroxybenzonitrile	Rhone-Poulenc
fenoxaprop - ethyl	(±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy] phenoxy]propanoic acid, ethyl ester	Hoechst-Roussel
M60	40:6 mixture of bentazon and MCPA	BASF
MCPA	(4-chloro-2-methylphenoxy)acetic acid	various
molinate	S-ethyl hexahydro-1H-azepine-1-carbothioate	Stauffer
propanil	N-(3,4-dichlorophenyl)propanamide	Rohm & Haas
RE-40855	not released at this time	Chevron
(continued)		

Table 7. Continued.

Name or code no. used in report	Chemical nature of active ingredient	Manufacturer
SC-0735	not released at this time	Stauffer
SC-9244	not released at this time	Stauffer
thiobencarb	S-[4-chlorophenyl)methyl]diethylcarbamothioate	Chevron
triclop pyr - amine	[(3,5,6-trichloro-2-pyridinyl)oxy] acetic acid	Dow
tridiphan	2-(3,5-dichlorophenyl)-2-(2,2,2-trichloroethyl)- oxirane	Dow
2,4-D - oil soluble amine	2,4-dichlorophenoxyacetic acid	Diamond-Shamrock
TW20	Tween 20 surfactant	
X77	nonionic surfactant	

Chemical Control of Red Rice in Rice ^{1/}

John B. Baker and James W. Shrefler

INTRODUCTION

The purpose of these investigations is the development of procedures which can be used by rice producers to control red rice. The two major areas of activity are the initial screening of herbicides in search of compounds which will selectively kill red rice with minimal damage to the seeded rice variety and integration of presently available red rice herbicides with other management practices to maximize the effectiveness of these herbicides.

MATERIALS AND METHODS

These experiments were conducted at the South Unit of the Rice Research Station in a field which had been overseeded in 1985 with red rice from a source near Kinder, Louisiana and allowed to mature in soybean crops in 1985 and 1986. The seed produced in 1985 were worked into the soil in the fall, but weather conditions in 1986 prevented fall and winter plowing. The soil at this site is a Midland silty clay loam. The fields were disc plowed in the spring as soon as weather conditions permitted and later they were chisel plowed and land leveled. They were retilled with a field cultivator as needed to prevent excessive weed growth, and just prior to seeding, the final seedbed was prepared.

In water-seeded tests levees were built, and the field to be seeded was flooded as quickly as possible. Normally, flooding was accomplished 2-3 days after seedbed preparation. Water-seeded tests were planted with presprouted Lemont rice at a rate equivalent to 125 lb/A of dry seed. Bags of seed to be presprouted were placed in a canal for 24 hours, placed on a rack to drain for an additional 24 hours, and then sown into the flooded test plots. In one test, the time interval between the initial flood and seeding was a variable in the experiment. Generally, the plots were drained within 24 hours after seeding and reflooded 5 days later. Time of fertilization of the water-seeded tests is given in footnotes of tables in the results and discussion section.

In experiments which were drill seeded, an 11-runner drill was used to seed 100 lb/A of Lemont. The tests were flush irrigated as needed to assure a stand. Just prior to applying the permanent flood, 400 lb/A of 20-10-10 was applied.

The preplant incorporated treatments were applied as sprays and incorporated as quickly as possible with a front-tine garden rototiller. Preplant surface treatments were applied as sprays or as granular treatments as soon after seedbed preparation as possible except where time of treatment was a variable. Sprays were applied in a volume of 15 GPA with a four-nozzel boom equipped with 80015 flat fan tips, spraying at a pressure of 32 psi and a

^{1/} This research was supported in part by funds provided by Louisiana rice farmers through the Rice Research Board.

ground speed of 2.5 mph. Granular formulations were applied by weighing out the amount needed for each plot and applying it to the area as uniformly as possible using a centrifugal spreader. In some cases additional blank granules were mixed with the formulated material to provide bulk so that a better distribution could be achieved. Information on treatments for each experiment is presented in the tables.

Information on herbicides tested is presented in Table 4.

Weed control and crop tolerance ratings were made in the herbicide screening tests. The rating scales used were as follows:

Rice tolerance:

- 1 - very severe injury with >90% stand reduction
- 2 - severe injury with 70 - 90% stand reduction
- 3 - moderate injury, 30 - 70 % stand reduction
- 4 - slight injury, primarily leaf burning and stunting
- 5 - no injury

Weed control:

- 1 - poor, <10% control
- 2 - slight, 10 - 30% control
- 3 - moderate, 30 - 70% control
- 4 - good, 70 - 90% control
- 5 - excellent, >90% control.

In experiments where red rice panicle density and Lemont yield were to be determined, 1.5'X6.0' sample areas were hand harvested, red rice panicle counts made, and the Lemont panicles from the sample area were bulked, threshed, cleaned and weighed for yield determination.

RESULTS AND DISCUSSION

Red rice control with preplant herbicides

Method of Application. Preplant molinate may be applied in various ways in water-seeded rice. It has been shown in previous studies that the effectiveness of preplant incorporated molinate was not significantly different from applications of the 10% granular formulation before or after working the seedbed in the water. This test was conducted primarily to evaluate the effectiveness of a preplant application of the 10% granular formulation of molinate to a flooded seedbed which had not been worked in the water. Also included for evaluation was an experimental 15% granular formulation of molinate. A preplant surface application of thiobencarb and a preplant incorporated application of molinate were included as herbicide standards. Treatments and data are presented in Table 1. The preplant incorporated molinate gave the best suppression of red rice, while the preplant surface thiobencarb and the preplant postflood application of the 15% granular molinate were at an intermediate level, being not significantly less effective than the preplant incorporated molinate nor more effective than the untreated control. The 10% granular molinate applied preplant postflood was not significantly different from the untreated check nor preplant surface thiobencarb, but it was less effective than the 15% granular molinate and the preplant incorporated molinate.

Lemont yields reflect not only the effect of red rice control on yield but also the effect of control of other weeds. Thiobencarb controlled purple ammonia and ducksalad, whereas molinate did not, consequently the thiobencarb treated plots yielded significantly higher.

Table 1. Red rice herbicide method of application test. Water-seeded rice.^{1/} Rice Research Station, Crowley, La. 1987.

Herbicide	Rate (lb ai/A)	Method of application ^{2/}	Red rice panicle density ^{3/} (panicles/m ²)	Lemont Yield ^{3/} (gm/m ²)
untreated	-	-	20.0 bc	280 c
thiobencarb	4	PPS	10.0 abc	478 a
molinate (EC)	4	PPI	2.0 a	312 bc
molinate (10G)	4	PPoF	26.8 c	363 bc
molinate (15G)	4	PPoF	8.8 ab	381 b

^{1/} Schedule of events: 4/22 - seedbed prepared; 4/29 - preplant treatments applied, flooded for seeding; 5/1 - presprouted Lemont seeded (125 lb/A dry seed equivalent) and flood removed; 5/6 - flooded; 5/26 - fertilized (100-50-50).

^{2/} PPS - preplant nonincorporated; PPI - preplant incorporated; PPoF - preplant postflood (not dragged).

^{3/} Means followed by the same letter are not significantly different at alpha = .05. Square root transformation performed on (1 + red rice panicle density) for ANOVA.

Time of herbicide application and flooding for seeding. Observations and tests in the past have suggested that two of the factors which may contribute to the performance of thiobencarb are the time of application of the herbicide following seedbed preparation and the time of flooding for seeding after seedbed preparation. This test included preplant surface applications of thiobencarb and preplant flooding for seeding, as soon as the levees were built (day-0) and 3 and 6 days later. Plots which were flooded at day-0 were subdivided to include an untreated plot and a plot treated with thiobencarb just prior to flooding. Plots which were flooded on day-3 were subdivided to include an untreated plot and thiobencarb plots treated at day-0 or day-3. Plots flooded at day-6 contained four subplots: no herbicide and thiobencarb at day-0, day-3 or day-6. All plots were seeded on the sixth day and drained for 5 days before establishing the permanent flood.

Red rice panicle density and Lemont yield are presented in Figures 1 and 2 respectively. It is obvious that time of flooding did not influence the red rice density in the no herbicide subplots, but it did influence performance of the herbicide. Subplots which were treated at day-0 gave very good red rice suppression provided they were flooded at day-0 or day-3, but when flooded at day-6 there was no apparent suppression of red rice. The subplots treated with herbicide at day-3 also had a lower red rice panicle density if they were flooded at day-3 rather than day-6. Subplots treated and flooded at day-6 had red rice panicle densities as high as the no herbicide plots.

Lemont yields reflect not only the effects of red rice but other weeds as well. Purple ammannia and other aquatic weeds were a greater problem in the plots that were flooded at day-0, and a less of a problem in the plots that were flooded at day-6. This is probably the result of holding the flood water for six days before seeding and draining. This effect of length of holding water prior to seeding and draining probably accounts for the trend to higher yields in the no herbicide subplots as the flooding time goes from 0 to 6 days. Since thiobencarb controlled most of the aquatic weeds, this effect of time of flooding is not as apparent in the thiobencarb treatments.

Red rice herbicide screening in drill-seeded rice.

Two tests were conducted to evaluate herbicides for efficacy in controlling red rice in drill-seeded rice. Treatments and ratings are presented in Table 2 and 3. In addition to making observations on red rice control, weed control ratings were taken on other weeds. Of the treatments presented in Table 2 SC-0500 as a postemergence treatment gave the best red rice control. Although there was rice injury at the high rate, the high level of control of most weeds permitted the rice to recover and yield well. This treatment was obviously weak on indian jointvetch and broadleaf signalgrass but very effective on other weeds in the test. Neither SC-0500 nor SC-0735 was effective as delayed preemergence treatments. Although the postemergence treatment with SC-0735 was not as effective in controlling red rice as SC-0500, it did appear to be less injurious to the crop and gave a broader spectrum of weed control.

The treatments presented in Table 3 are primarily grass herbicides which have been reported to show some selectivity of action on red rice. This test was complicated by the presence of a heavy infestation of junglerice, eclipta, rice flatsedge and indian jointvetch. At the rates and times of application tested, none of the herbicides showed sufficient selectivity as far as red rice

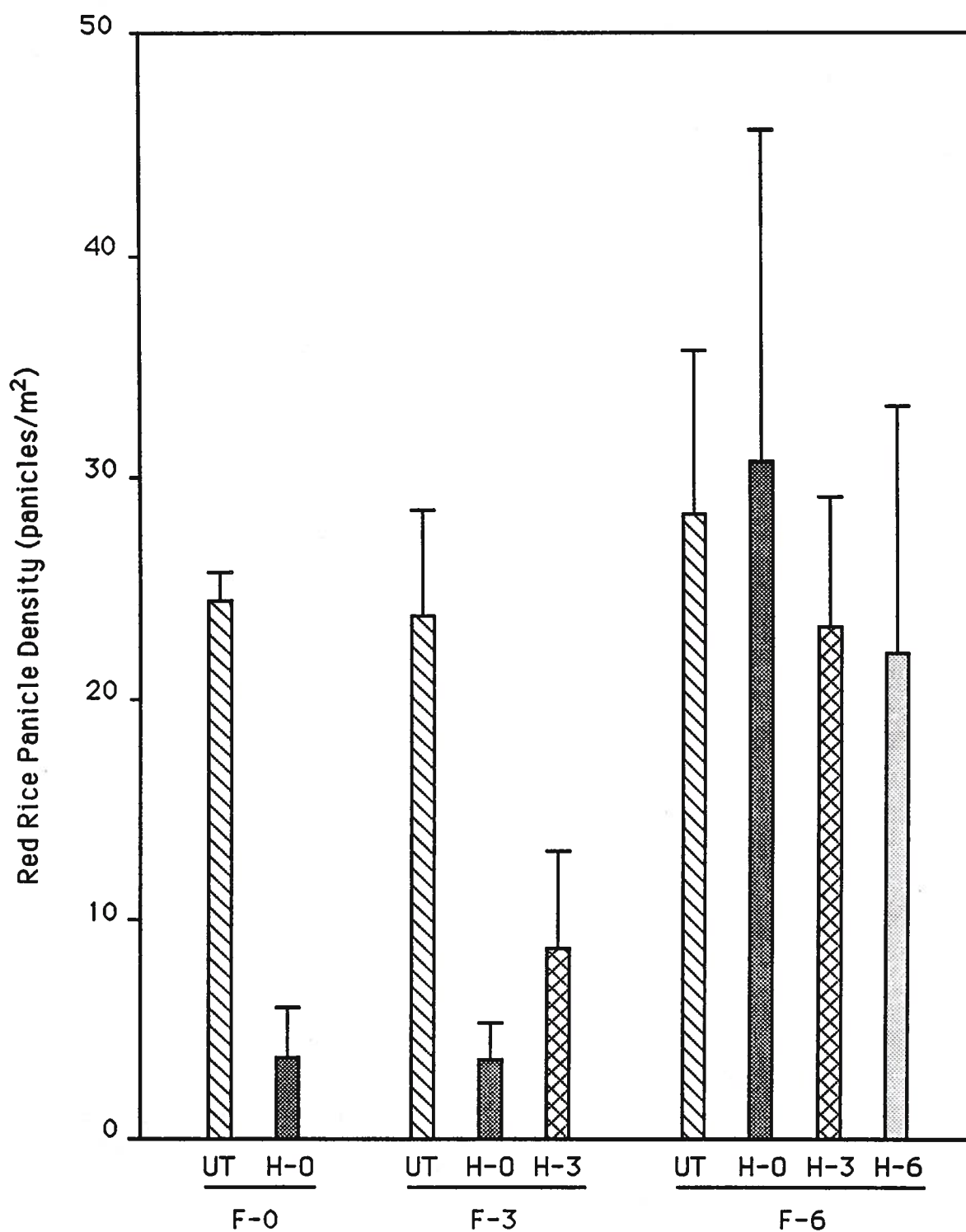


Figure 1. Effect of time of flooding for seeding and time of herbicide application on red rice panicle density. UT – no herbicide; H-0, H-3, H-6 – herbicide applied 0, 3, or 6 days after seedbed preparation; F-0, F-3, F-6 – preplant flood applied 0, 3, or 6 days after seedbed preparation.

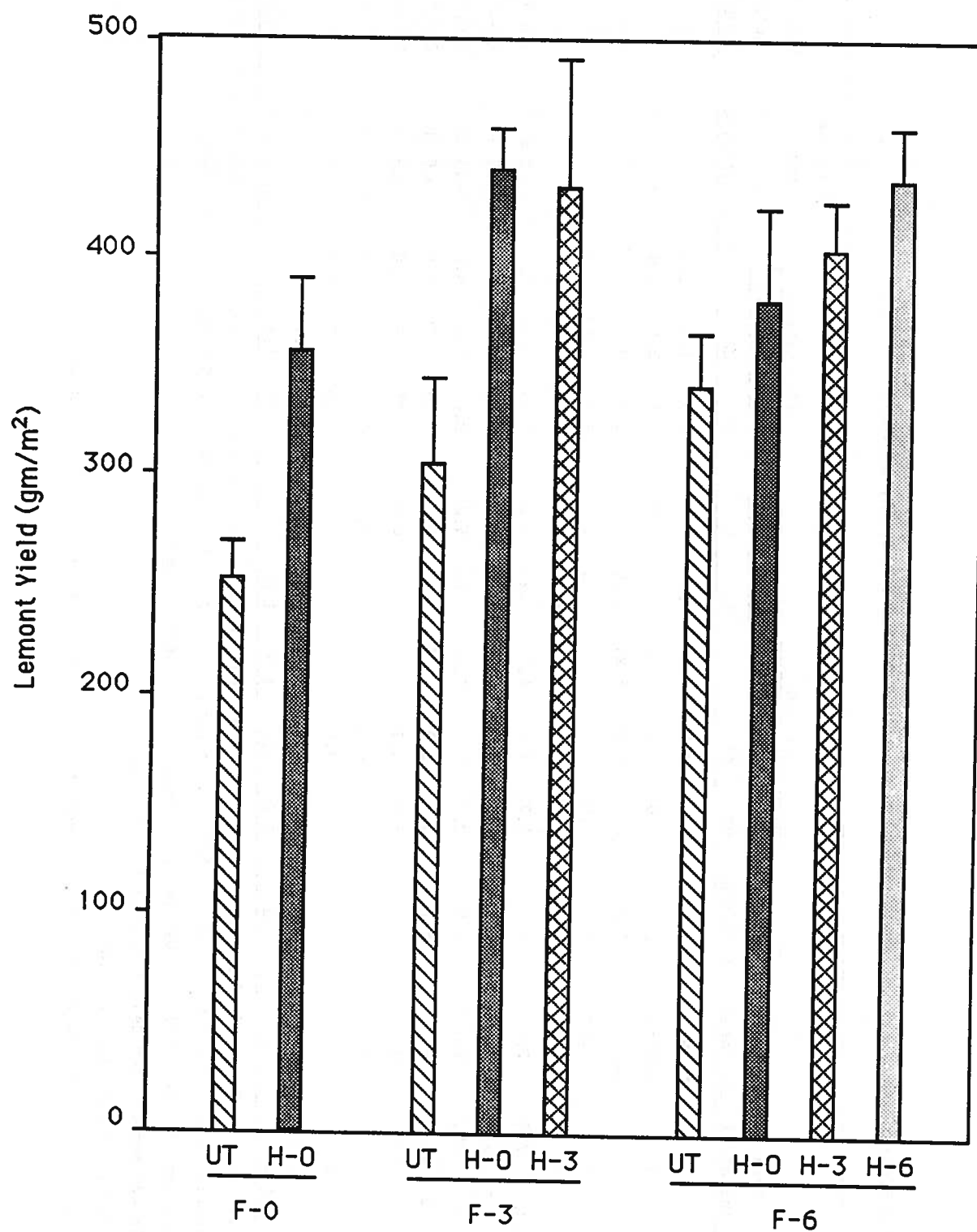


Figure 2. Effect of time of flooding for seeding and time of herbicide application on Lemont yield. UT – no herbicide; H-0, H-3, H-6 – herbicide applied 0, 3, or 6 days after seedbed preparation; F-0, F-3, F-6 – preplant flood applied 0, 3, or 6 days after seedbed preparation.

Table 2. Red rice herbicide screening in drill-seeded rice.^{1/} Rice Research Station, Crowley, La. 1987.

Herbicide	Rate (oz ai/A)	Time of ^{2/} treatment	Rice tolerance	6/5 Ratings ^{3/}					7/23 Ratings ^{3/}					Red rice	
				Weed Control ^{4/}					Weed Control ^{4/}					panicle density ^{5/} (panicles/m ²)	Lemont yield ^{5/} (gm/m ²)
				OS	CI	BP	EA	EC	OS	EC	AV/I	AV/I	AV/I		
SC-0735	1	DelPre	4.75	1.0	2.25	1.5	2.0	1.25	1.0	1.25	1.0	1.0	1.25	-	-
SC-0735	2	DelPre	5.0	1.0	2.0	1.75	2.75	1.75	1.5	2.5	1.0	1.0	2.5	-	-
SC-0735	4	DelPre	4.75	1.75	2.75	3.25	3.25	2.75	1.5	3.0	1.75	1.0	3.0	-	-
SC-0500	3	DelPre	4.75	1.0	1.5	1.25	2.25	1.0	1.0	1.25	1.25	1.0	1.25	-	-
SC-0500	6	DelPre	4.75	1.25	2.5	1.5	2.75	1.25	1.0	1.75	1.0	1.0	1.75	-	-
SC-0735 + TW20	.67 + .25%	Po	5.0	1.75	5.0	4.25	3.25	4.25	2.0	3.25	2.5	2.0	3.25	81.5 a	226.3 ab
SC-0735 + TW20	1 + .25%	Po	4.75	2.5	5.0	5.0	3.25	4.75	3.0	4.5	2.0	3.0	4.5	92.3 a	275.3 ab
SC-0735 + TW20	1.5 + .25%	Po	4.5	2.75	5.0	5.0	4.25	5.0	3.0	5.0	4.0	3.0	5.0	64.5 ab	310.3 a
SC-0500 + TW20	2 + 1%	Po	4.75	3.5	5.0	2.75	3.25	4.0	4.25	4.25	2.5	4.25	4.25	30.0 b	260.2 ab
SC-0500 + TW20	4 + 1%	Po	4.0	3.25	4.75	2.75	4.5	4.5	4.25	4.5	3.0	4.25	4.5	26.3 b	269.3 ab
SC-0500 + TW20	8 + 1%	Po	3.0	4.25	4.25	3.25	4.75	5.0	4.5	4.25	3.5	4.5	4.25	27.5 b	320.8 a
molinate	64	PPI	4.75	2.25	3.0	2.75	2.75	2.75	2.25	2.5	1.0	-	2.5	-	-
thiobencarb	64	DelPre	5.0	1.75	4.0	2.5	3.25	2.75	1.5	4.5	1.0	-	4.5	-	-
untreated	-	-	5.0	1.0	1.0	1.0	1.0	1.0	1.25	1.5	1.0	1.0	1.5	88.3 a	54.4 c

^{1/} Schedule of events: 4/13 - seedbed prepared; 4/22 - PPI treatment, drill seeded Lemont (.100 lb/A); 4/23 - flushed; 4/27 - DelPre treatments; 4/28, 5/4, 5/5 - flushed; 5/15 - Po treatments; 6/1 - fertilized (.100-50-50); 6/5 - flooded.

^{2/} PPI - preplant incorporated, DelPre - delayed preemergence, Po - postemergence.

^{3/} See materials and methods for description of rating scales.

^{4/} See Table 5 for identification of weeds.

^{5/} Treatment means within a column followed by the same letter are not significantly different at alpha = .05.

Table 3. Red rice and grass herbicide test. Drill-seeded.^{1/} Rice Research Station, Crowley, La. 1987.

Herbicide	Rate (lb ai/A)	Time of treatment	Rice Tolerance	6/5 Ratings ^{2/}				7/16 Ratings ^{2/}			
				Weed Control Ratings ^{3/}				Weed Control Ratings ^{3/}			
				OS	CI	Gr	EA	OS	EC	CI	AV/I EA
untreated	-	-	4.75	1.00	1.00	2.50	1.00	1.0	1.0	1.0	2.0 1.25
fenoxaprop-ethyl	.075	Po	4.50	1.00	1.00	5.00	1.00	1.25	5.0	1.0	1.0 1.0
fenoxaprop-ethyl	.15	Po	4.00	1.75	1.00	5.00	1.00	3.0	5.0	1.0	2.0 1.0
fenoxaprop-ethyl	.30	Po	3.50	2.00	1.00	5.00	1.00	3.5	5.0	1.0	1.0 1.0
fenoxaprop-ethyl	.075	LPO	5.00	1.00	1.00	1.50	1.25	1.5	3.5	1.0	1.0 1.5
fenoxaprop-ethyl	.15	LPO	5.00	1.00	1.00	1.50	1.00	1.75	5.0	1.0	1.0 1.0
fenoxaprop-ethyl	.30	LPO	5.00	1.00	1.00	1.50	1.00	3.0	5.0	1.0	1.0 1.0
fenoxaprop-ethyl	.075	VLPo	5.00	1.00	1.00	1.00	1.00	1.25	2.5	1.0	1.0 1.0
fenoxaprop-ethyl	.15	VLPo	5.00	1.00	1.25	1.25	1.00	1.5	4.75	1.0	1.25 1.5
fenoxaprop-ethyl	.30	VLPo	4.50	1.00	1.00	1.50	1.00	1.75	4.75	1.0	1.0 1.0
haloxyfop-methyl + X77	.0625 + .25%	Po	3.25	1.25	1.00	5.00	1.00	2.75	5.0	1.0	1.25 1.0
haloxyfop-methyl + X77	.09375 + .25%	Po	2.75	2.50	1.00	5.00	1.00	2.5	5.0	1.0	1.0 1.0
haloxyfop-methyl + X77	.125 + .25%	Po	2.50	2.75	1.00	5.00	1.00	3.5	5.0	1.0	1.25 1.0
haloxyfop-methyl + X77	.1875 + .25%	Po	1.50	4.25	1.00	5.00	1.00	4.5	5.0	1.0	1.25 1.0
sethoxydim + OC	.05 + 1 qt	Po	5.00	1.00	1.00	5.00	1.00	2.25	4.75	1.0	1.75 1.0
sethoxydim + OC	.10 + 1 qt	Po	4.25	1.50	1.00	5.00	1.00	1.5	5.0	1.0	1.25 1.0
sethoxydim + OC	.20 + 1 qt	Po	3.50	2.50	1.25	5.00	1.25	3.0	5.0	1.0	1.75 1.25
sethoxydim + OC	.05 + 1 qt	LPO	5.00	1.00	1.00	1.75	1.00	1.5	1.5	1.0	1.0 1.0
sethoxydim + OC	.10 + 1 qt	LPO	5.00	1.00	1.00	2.25	1.00	1.25	4.75	1.0	1.0 1.0
RE-45601 + OC	.08 + 1 qt	Po	3.00	2.00	1.00	5.00	1.00	2.25	5.0	1.0	1.0 1.0
RE-45601 + OC	.16 + 1 qt	Po	2.00	3.50	1.00	5.00	1.00	3.75	5.0	1.0	1.0 1.0
RE-45601 + OC	.04 + 1 qt	VLPo	5.00	1.00	1.00	1.00	1.00	5.0	5.0	1.0	3.0 1.0
RE-45601 + OC	.08 + 1 qt	VLPo	5.00	1.00	1.00	1.50	1.00	2.5	3.0	1.0	1.0 1.25
RE-45601 + OC	.16 + 1 qt	VLPo	5.00	1.00	1.00	1.00	1.00	3.25	5.0	1.0	1.25 1.5
propanil + triclopyr	1.5 + .10	LPO	4.75	1.00	1.00	2.50	1.00	2.25	3.75	1.25	1.5 1.5
propanil + triclopyr	3.0 + .19	LPO	5.00	1.00	3.75	3.75	3.75	1.25	2.5	4.5	5.0 4.5
propanil + triclopyr	6.0 + .39	LPO	5.00	1.00	5.00	5.00	5.00	1.5	4.25	5.0	5.0 5.0
propanil + triclopyr	2.0 + .19	LPO	4.75	1.25	5.00	5.00	5.00	1.0	4.75	5.0	5.0 5.0
propanil + triclopyr	2.0 + .29	LPO	5.00	1.00	5.00	4.50	4.75	1.0	3.25	4.75	5.0 5.0
propanil + triclopyr	3.0 + .29	LPO	5.00	1.00	5.00	4.75	5.00	1.0	3.25	5.0	5.0 5.0
propanil + triclopyr	3.0 + .10	LPO	5.00	1.00	4.75	4.75	4.75	1.0	4.0	5.0	5.0 5.0
propanil	3.0	LPO	5.00	1.00	5.00	4.25	4.25	1.0	3.5	4.75	4.75 4.5

^{1/} Schedule of events: 4/13 - seeded prepared; 4/22 - Lemont drill-seeded (ca. 100 lb/A); 4/23, 4/28, 5/4 - flush irrigated; 5/5 - emergence; 5/15 - Po treatments (3-4 leaf rice); 6/1 - LPO treatments (1-2 tillers), fertilized (100-50-50); 6/5 - flooded; 6/16 - VLPo treatments.

^{2/} See materials and methods for description of rating scales.

^{3/} See Table 5 for weed identification.

^{4/} Po - 3-4 leaf rice, 10 days after emergence, 23 days after seeding, 32 days after seedbed preparation.
LPO - 1-2 tiller rice, 27 days after emergence. VLPo - late tillering, 42 days after emergence.

control is concerned, but their effectiveness in controlling grasses was confirmed. Both RE-45601 and haloxyfop-methyl were too toxic to rice at the rates tested. At low rates both fenoxaprop-ethyl and sethoxydim selectively controlled junglerice. At the higher rates they were quite toxic to the rice. Combinations of propanil and triclopyr were evaluated to see if they were more effective in controlling junglerice than propanil alone. There did not seem to be a great improvement in junglerice control except where the propanil rate was twice as high. When the propanil rate was 1.5 lb ai/A, junglerice control was reduced.

SUMMARY

Preplant postflood application of the 10% granular formulation of molinate to a nondragged seedbed was found to be less effective in controlling red rice than a preplant incorporated application at the same rate of molinate as a spray. Although thiobencarb applied as a preplant nonincorporated treatment gave an intermediate level of red rice control, the Lemont yield was significantly higher because control of other weeds was superior. Best red rice control was obtained with preplant surface thiobencarb when the preplant flood was applied within three days of seedbed preparation. Holding the preplant flood for as short a time as possible before planting and draining was less conducive to establishment of aquatic weeds. SC-0500 and SC-0735 applied postemergence in drill-seeded rice gave some red rice control. SC-0500 was better at all rates than the lower rates of SC-0735. These experimental herbicides also controlled rice flatsedge, junglerice, and, to a lesser degree, eclipta and jointvetches. SC-0735 was excellent on broadleaf signalgrass, but SC-0500 was not. None of the postemergence grass herbicides tested gave selective control of red rice in rice at the rates tested. At rates that controlled red rice, they were too toxic to the Lemont.

Table 4. Herbicides tested in studies at the Rice Research Station, Crowley, LA. 1987.

Name or code no. used in report	Chemical nature of active ingredient	Manufacturer
fenoxaprop - ethyl	($\pm$)-2-[4-[(6-chloro-2-benzoxazolyl)oxy] phenoxy]propanoic acid, ethyl ester	Hoechst-Roussel
haloxyfop - methyl	2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl] oxy]phenoxy]propanoic acid, methyl ester	Dow
molinate	S-ethyl hexahydro-1H-azepine-1-carbothioate	Stauffer
OC	crop oil concentrate	
propanil	N-(3,4-dichlorophenyl)propanamide	Rohm & Haas
RE-45601	not released at this time	Chevron
SC-0500	not released at this time	Stauffer
SC-0735	not released at this time	Stauffer
sethoxydim	2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio) propyl]-3-hydroxy-2-cyclohexen-1-one	BASF
thiobencarb	S-[4-chlorophenyl)methyl]diethylcarbamothioate	Chevron
triclopyr	[(3,5,6-trichloro-2-pyridinyl)oxy] acetic acid	Dow
TW-20	Tween 20 surfactant	
X77	nonionic surfactant	

Table 5. Weeds rated in herbicide test conducted at the Rice Research Station, Crowley, LA. 1987.

Abbreviation used in tables	Common name	Scientific name
AI	Indian jointvetch	<u>Aeschynomene indica</u>
AV	northern jointvetch	<u>Aeschynomene virginica</u>
BP	broadleaf signalgrass	<u>Brachiaria platyphylla</u>
CI	rice flatsedge	<u>Cyperus iria</u>
EA	eclipta	<u>Eclipta alba</u>
EC	junglerice	<u>Echinochloa colona</u>
Gr	annual grasses	
OS	red rice	<u>Oryza sativa</u>

RICE INSECT CONTROL STUDIES

RICE WATER WEEVIL CONTROL: PREPLANT INCORPORATED CARBOFURAN

J.F. Robinson, C.M. Smith, G.B. Trahan, and R.M. Michot

Location: Rice Research Station, Crowley, LA

Soil: Silt-Loam

Variety: Lemont and Mars

Seeding Rate: 140 lb/A

Seeding Depth: surface

Planting Method: Water seeded Apr 24, 1987, pre-sprouted seed

Plot Size: Planted: 16 ft x 56 in
Harvested: 16 ft x 28 in

Fertilization: 120-60-60 Apr 20

Water Management: Flooded Apr 24; Drained Apr 28
Flooded May 1; Drained for harvest Aug 17

Herbicides: Bolero, 4 lb ai/A Apr 24, surface applied spray

Application Equipment: Bolero applied with a CO₂ hand boom, 15 gpa at 30 psi;
Granular insecticide applied with a shaker jar; PPI
treatments incorporated about 1 in deep with hand rake

Experimental Design: Randomized complete block design with 4 reps

Harvested: Sept 4 with a Kubota small plot combine

Comments: Carbofuran, 0.50 lb ai/A, applied PPI gave rice water weevil control comparable to the standard postflood application. A poor stand in Lemont contributed to the significant differences in yield between the two varieties. These data indicate that there is no phytotoxic interaction between preflood surface application of Bolero and PPI applied Carbofuran for either variety. However, a similar test conducted in 1986 with only Lemont indicated a possible interaction at rates above 0.50 lb ai/A.

Table 1. Rice water weevil control in a water seeded system with a preflood surface application of Bolero as the herbicide and Carbofuran applied preplant incorporated. Rice Research Station, Crowley, LA. 1987.

Variety	Carbofuran (lb ai/A)	Appl.	June 18 L/C	Height (cm)	Yield (lb/A)
Mars	0.00	---	16.1a	107.2 c	6466 bc
Mars	0.25	PPI	9.8 b	107.8 bc	6321 cd
Mars	0.50	PPI	7.5 bc	110.5abc	7322ab
Mars	0.75	PPI	3.7 c	112.1ab	7490a
Mars	1.00	PPI	3.7 c	111.3abc	7888a
Mars	0.50	PoF	5.8 bc	114.2a	7241ab
Lemont	0.00	---	14.6a	81.7 d	5126 e
Lemont	0.25	PPI	7.5 bc	82.9 d	5655 cde
Lemont	0.50	PPI	5.8 bc	83.1 d	5489 de
Lemont	0.75	PPI	3.6 c	82.2 d	5572 cde
Lemont	1.00	PPI	3.2 c	82.8 d	5463 de
Lemont	0.50	PoF	4.9 c	81.7 d	5283 e

PPI = preplant incorporated; PoF = postflood; L/C = number of rice water weevil immatures per 3 5/8-in (dia) x 3-in (depth) core sample; plots flooded and seeded with pre-sprouted seed April 24, 1987; plots drained April 28, 1987 and then re-flooded May 1, 1987; Carbofuran PoF applied June 5, 1987

RICE WATER WEEVIL CONTROL: SC-0567

J.F. Robinson, C.M. Smith, G.B. Trahan, and R.M. Michot

Location: Rice Research Station, Crowley, LA

Soil: Crowley silt loam

Variety: Mars

Seeding Rate: 100 lb/A

Seeding Depth: 1.5 in

Planting Method: Drill seeded, Apr 16, 1987

Plot Size: Planted: 16 ft x 49 in (7 rows on 7-in centers)
Harvested: 16 ft x 28 in

Fertilization: 30-60-60 lb/A N-P-K at planting
120 lb/A N, May 21

Water Management: Flushed Apr 20, 24, 29, and May 1; Flooded May 22
Drained Aug 13

Herbicides: Propanil, 4 lb ai/A, May 20

Application Equipment: Propanil applied with a CO₂ hand boom delivering 15 gpa at 30 psi; Granular insecticides applied with a shaker jar; pre-plant incorporated (PPI) treatments incorporated about 1-in depth with a hand rake

Experimental Design: Randomized complete block with 4 reps

Harvested: Sept 3 with Kubota small plot combine

Comments: Preflood applications of SC-0567 at rates of 1.0, 1.5, and 2.0 lb ai/A gave excellent rice water weevil control and were more effective than either preplant incorporated or postflood applications. No phytotoxicity was observed with any treatments.

Table 1. Rice water weevil control with different application timings and rates of SC-0567. Rice Research Station, Crowley, LA. 1987.

Insecticide	Rate (lb ai/A)	Appl.	Number RWW immatures per core	Yield (lb/A)
SC-0567	1.0	PPI	11.3abc	6902 bc
SC-0567	1.5	PPI	14.6a	7174abc
SC-0567	2.0	PPI	14.2ab	7248abc
Carbofuran	0.5	PPI	9.9 c	7043abc
SC-0567	1.0	PeF	0.8 d	7732a
SC-0567	1.5	PeF	2.8 d	7572ab
SC-0567	2.0	PeF	0.7 d	7802a
Carbofuran	0.5	PeF	2.6 d	7512ab
SC-0567	1.0	PoF	8.3 c	7131abc
SC-0567	1.5	PoF	10.8 bc	6877 bc
SC-0567	2.0	PoF	8.8 c	6700 c
Carbofuran	0.5	PoF	3.7 d	7478ab
Check	---	---	10.0 c	7562ab

*** PPI= preplant incorporated applied April 16, 1987; PeF= preflood applied May 22, 1987; PoF = postflood applied June 8, 1987; core sample= 3 5/8 in (dia) x 3 in (depth); immature counts made June 18, 1987.

RICE WATER WEEVIL CONTROL: COUNTER

J.F. Robinson, C.M. Smith, G.B. Trahan, and R.M. Michot

Location: Rice Research Station, Crowley, LA

Soil: Crowley silt loam

Variety: Mars

Seeding Rate: 100 lb/A

Seeding Depth: 1.5 in

Planting Method: Drill seeded, Apr 16, 1987

Plot Size: Planted: 16 ft x 49 in (7 rows on 7-in centers)
Harvested: 16 ft x 28 in

Fertilization: 30-60-60 lb/A N-P-K at planting
120 lb/A N May 21

Water Management: Flushed Apr 20, 24, 29, and May 1; Flooded May 22;
Drained Aug

Herbicides: Propanil, 4 lb ai/A, May 20

Application Equipment: Propanil applied with a CO₂ hand boom delivering 15 gpa at 30 psi; Granular insecticides applied with a shaker jar; preplant incorporated (PPI) treatments incorporated about 1-in depth with a hand rake

Experimental Design: Randomized complete block with 4 reps

Harvested: Sept 4 with Kubota small plot combine

Comments: Preflood applications of Counter at rates of 1.0, 1.5, and 2.0 lb ai/A gave excellent rice water weevil control and were more effective than either preplant incorporated or postflood applications. No phytotoxicity was observed with any treatments.

Table 1. Rice water weevil control with different application timings and rates of Counter. Rice Research Station, Crowley, LA. 1987.

Treatment	Rate (lb ai/A)	Appl.	Immatures per core	Yield (lb/A)
Check	0.0	PPI	10.2a	7499
Counter	1.0	PPI	11.8a	7319
Counter	1.5	PPI	7.8ab	7552
Counter	2.0	PPI	7.3ab	7231
Check	0.0	PeF	10.6a	7369
Counter	1.0	PeF	1.8 d	7439
Counter	1.5	PeF	1.6 d	7433
Counter	2.0	PeF	2.6 bcd	7161
Carbofuran	0.5	PeF	2.0 cd	7663
Check	0.0	PoF	7.1abc	7398
Counter	1.0	PoF	9.2a	7018
Counter	1.5	PoF	10.6a	7427
Counter	2.0	PoF	8.3a	7491
Carbofuran	0.5	PoF	1.5 d	7743

*** PPI= preplant incorporated applied April 16, 1987; PeF= preflood applied May 22, 1987; PoF = postflood applied June 8, 1987; core sample= 3 5/8 in (dia) x 3 in (depth); immature counts made June 19, 1987.

RICE WATER WEEVIL CONTROL: DIMILIN

J.F. Robinson, C.M. Smith, G.B. Trahan, and R.M. Michot

Location: Rice Research Station, Crowley, LA

Soil: Crowley silt loam

Variety: Mars

Seeding Rate: 100 lb/A

Seeding Depth: 1.5 in

Planting Method: Drill seeded, May 19, 1987

Plot Size: Planted: 20 ft x 49 in (7 rows on 7-in centers)
Harvested: 20 ft x 28 in

Fertilization: 30-60-60 lb/A N-P-K at planting
120 lb/A N June 5

Water Management: Flooded June 9; Drained Aug 31

Herbicides: Propanil, 4 lb ai/A, June 3 and 5

Application Equipment: Propanil, first application by airplane; second application applied with a CO₂ hand boom delivering 15 gpa at 30 psi; Granular insecticides applied with a shaker jar; preplant incorporated (PPI) treatments incorporated about 1-in depth with a hand rake

Experimental Design: Randomized complete block with 4 reps; Plots individually leveed off

Harvested: Sept 24 by hand

Comments: Dimilin, 1 oz at 6 days plus 1 oz at 13 days and 2 oz at 6 days, gave rice water weevil control comparable to the carbofuran standard.

Table 1. Rice water weevil control with postflood applications of Dimilin.
Rice Research Station, Crowley, LA. 1987.

Treatment	Rate (ai/A)	Time Days PoF	Immatures per core	Yield (lb/A)
Dimilin	0.5 oz	6	20.3 b	4095
	0.5 + 0.5 oz	6 + 13	10.6 c	4324
	1.0 oz	6	14.1 c	4203
	1.0 + 1.0 oz	6 + 13	6.3 de	4158
	2.0 oz	6	6.5 de	4164
Carbofuran	0.5 lb	6	2.3 e	3889
Check	0.0	----	27.7a	4334

PoF = postflood; plots flooded June 9, 1987; core sample = 3 5/8 in (dia) x 3 in (depth); immature counts made July 1, 1987.

EVALUATION OF TISSUE CULTURE LINES FOR RICE WATER WEEVIL RESISTANCE

J.F. Robinson, T.P. Croughan, G.B. Trahan, R.M. Michot, and M.M. Meche

Eighty rice lines regenerated from tissue culture were evaluated in a field test for rice water weevil resistance. The lines were planted in single row plots, 3 feet in length on 18-inch centers, on July 20, 1987. Plots were flooded on August 8, 1987, and rice water weevil immature counts were taken on August 27, 1987. These data are summarized in Table 1. Lines with low immature counts will be tested again in 1988.

Table 1. Evaluation of rice lines derived from tissue culture for rice water weevil resistance. Rice Research Station, Crowley, LA. 1987.

Pedigree	N	Immatures per Core		
		Minimum	Maximum	Mean
Lebonnet				
46-734	1	1.00	1.00	1.00
74-437	5	0.00	5.00	1.80
54-32	1	2.00	2.00	2.00
74-433	5	0.00	6.00	2.60
74-440	5	0.00	7.00	2.60
LBNT CK	3	1.00	4.00	2.67
74-439	5	0.00	6.00	3.40
74-436	4	1.00	6.00	3.50
74-438	4	1.00	7.00	3.75
46-863	1	4.00	4.00	4.00
54-34	2	1.00	7.00	4.00
Mars				
74-414	5	2.00	20.00	8.00
Mars CK	2	0.00	2.00	1.00
Starbonnet				
46-657	1	0.00	0.00	0.00
74-449	4	0.00	3.00	1.25
74-446	5	0.00	6.00	1.80
46-1188	1	3.00	3.00	3.00
74-451	5	0.00	6.00	3.00
STBN CK	3	1.00	9.00	4.00
74-452	5	1.00	17.00	6.80
46-368	1	7.00	7.00	7.00

Continued.

Table 1 continued.

Pedigree	N	Immatures per Core		
		Minimum	Maximum	Mean
Saturn				
74-424	5	0.00	6.00	2.00
STRN CK	4	1.00	4.00	2.75
74-427	5	0.00	6.00	3.00
74-421	5	2.00	10.00	5.00
74-422	5	1.00	10.00	5.40
74-423	5	1.00	14.00	6.40
74-425	5	1.00	28.00	7.20
74-420	5	6.00	15.00	9.00
Lemont				
74-369	1	0.00	0.00	0.00
74-262	5	0.00	3.00	0.80
74-253	2	0.00	2.00	1.00
74-320	5	0.00	5.00	1.00
74-222	5	0.00	4.00	1.20
74-56	5	0.00	3.00	1.40
74-372	5	0.00	4.00	1.40
74-250	5	0.00	4.00	1.40
74-97	5	0.00	3.00	1.60
74-99	5	1.00	3.00	1.60
74-177	5	0.00	4.00	1.60
74-256	5	0.00	6.00	1.60
74-244	5	0.00	5.00	1.60
74-41	3	1.00	3.00	1.67
74-341	5	0.00	8.00	1.80
74-325	5	0.00	5.00	1.80
74-251	5	0.00	4.00	1.80
74-152	5	0.00	4.00	1.80
74-354	5	0.00	8.00	2.00
LMNT CK	16	0.00	15.00	2.19
74-1	5	0.00	5.00	2.20
74-338	5	0.00	6.00	2.20
74-364	5	0.00	9.00	2.40
74-305	5	1.00	8.00	2.40
74-335	5	0.00	4.00	2.40
74-146	5	0.00	10.00	2.60
74-254	5	1.00	5.00	2.60
74-322	5	1.00	5.00	2.80
74-205	5	0.00	7.00	2.80
74-132	5	1.00	8.00	3.00
74-326	4	1.00	5.00	3.00
74-66	5	0.00	6.00	3.00

Continued.

Table 1 continued.

Pedigree	N	Immatures per Core		
		Minimum	Maximum	Mean
Lemont (continued)				
74-353	5	0.00	11.00	3.00
74-74	5	0.00	7.00	3.00
74-313	5	0.00	9.00	3.20
74-206	5	0.00	6.00	3.20
74-226	5	0.00	8.00	3.20
74-394	5	0.00	9.00	3.20
74-255	5	0.00	7.00	3.40
74-218	5	0.00	7.00	3.40
74-386	5	0.00	10.00	3.40
74-243	5	1.00	8.00	3.60
74-128	5	0.00	8.00	3.60
74-8	5	2.00	9.00	3.60
74-86	5	0.00	12.00	3.60
74-71	5	1.00	6.00	4.00
74-127	5	1.00	9.00	4.00
74-343	5	1.00	7.00	4.20
74-87	5	0.00	7.00	4.60
74-142	5	0.00	11.00	5.00
74-214	5	1.00	12.00	5.20
74-143	5	2.00	8.00	5.40
74-382	3	3.00	20.00	9.00
74-185	5	1.00	25.00	10.20

Rice water weevil immatures per 3 5/8-in (dia.) x 3-in (depth) core sample.

RICE STINK BUG INSECTICIDE BIOASSAY PROCEDURE

J.F. Robinson, C.M. Smith, G.B. Trahan, and R.M. Michot

A laboratory bioassay procedure was developed for determining the efficacy of various insecticides against the rice stink bug. The procedure is outlined below.

1. A stock solution of the desired concentration, parts per million (ppm), was prepared by placing the appropriate amount of insecticide into solution. The following formula was used.

$$\frac{(\text{ppm stock})}{1,000,000} \times \frac{(\text{total vol.})}{(\% \text{ insecticide})}$$

2. The desired treatment levels (ppm) were prepared by adding the appropriate amount of stock solution and water to give the desired total volume. The following formula was used.

$$\frac{\text{ppm stock}}{\text{total vol. desired}} = \frac{\text{ppm desired for trt.}}{\text{ml stock}}$$

3. Panicles in the milk to early dough stage were collected from the field, brought into the laboratory, and the temperature allowed to equilibrate, about 30 min.
4. A single panicle was submerged in a treatment solution for 1 minute.
5. The panicle was removed from the treatment solution, shaken 25 times to remove excess solution, allowed to air dry for 5 minutes, and then placed in a 1-quart fruit jar.
6. Three pair of adult rice stink bugs were placed in each jar and the jar was closed using the ring and metal lid.
7. Mortality was recorded at the end of 24 hours.

Results are summarized in Table 1. The percentage mortality for methyl parathion was 100 % at all levels (ppm) tested. The highest level of Sevin tested, 400 ppm, gave 83% mortality. At the 25 ppm level, Orthene gave 67% mortality and F6704 gave 83% mortality. F6308 gave 92% mortality at the 50 ppm level.

Table 1. Percentage mortality for five insecticides tested in the laboratory against the rice stink bug. Rice Research Station, Crowley, LA. 1987.

ppm	Insecticide				
	Sevin	Methyl Parathion	Orthene	F6704	F6308
400	83	100	100	92	100
200	50	100	100	100	100
100	8	100	83	92	67
50	17	100	67	92	92
25	0	100	67	83	25
0	0	8	0	8	0

Percent mortality at 24 hrs.; 6 adults/jar; 2 jars per treatment.

DISEASE CONTROL STUDIES

DEVELOPMENT OF DISEASE RESISTANT RICE GERMPLASM^{1/}

(A Progress Report)

D.E. Groth, M.C. Rush, M. Frey, and J. Nugent

INTRODUCTION

Disease damage to rice can greatly impair productivity, and in some instances, totally destroy a crop. Fortunately, the United States does not have any of the destructive viral diseases that are present in other rice growing areas of the world. However, fungal diseases are prevalent and can be very destructive to Louisiana rice crops and a new bacterial disease has been found. The more important rice diseases in Louisiana include sheath blight caused by Rhizoctonia solani Kuhn, blast caused by Pyricularia oryzae Cav., water molds caused by Pythium and Achlya spp., brown spot caused by Bipolaris oryzae B. deHann, stem rot caused by Sclerotium oryzae Cutt., narrow brown spot caused by Cercospora oryzae Miyake, and kernel smut caused by Neovossia horrida (Bref.) Sacc. & Syd. Bacterial leaf blight caused by Xanthomonas campestris pv. oryzae was found in one parish.

The objectives of this project were 1) to identify and estimate severity of the diseases occurring in the rice producing regions of Louisiana, 2) to introduce new germplasm for the breeding for disease resistance in the rice improvement program at the Rice Research Station, and 3) screen lines for disease resistance.

MATERIALS AND METHODS

1986 Rice Disease Survey. The disease survey for bacterial leaf blight in commercial rice fields was conducted in the summer of 1987. Fields with maturing rice were selected at random. Ratoon rice was also surveyed for bacterial blight infection. Ten sampling sites were inspected in each field at random locations. The variety of rice was determined for each field whenever possible.

RESULTS AND DISCUSSION

1986 Rice Disease Survey. In 1987, bacterial blight was found in one field of rice in Louisiana. It was found on the long-grain variety Lemont in Acadia parish. No bacterial blight was identified in any other fields in the area or in the state. No second crop rice showed bacterial blight symptoms.

^{1/} This research is supported in part by funds provided by rice producers through the Louisiana Rice Research Board.

MATERIALS AND METHODS

1987 Disease Nurseries. The sheath blight-foliar disease nursery was planted using four grams of seed of each entry drill seeded into each of two 4-ft rows. Row spacing was 10 inches with 3 ft between tiers of rows. Propanil was applied at 4 lb/A to control weeds. The nursery was fertilized at a 100-50-50 (N, P₂O₅, K₂O) lb/A rate and a permanent flood of 4 to 6 inches in depth was established.

All plots in the sheath blight nursery were inoculated with a rice seed: rice hull:fungus inoculum at a rate of 50 ml/2 row plot. Inoculum was prepared by inoculating a moist, autoclaved (1 hr at 15 lb pressure on 2 consecutive days) rice grain:rice hull medium (1:2) in 2-liter flasks with plugs from a 5-day old PDA culture of *Rhizoctonia solani* (isolate LR-172). The inoculum was incubated at 28°C for 14 days. After incubation, the inoculum was removed from the flasks, broken into small pieces, mixed with fresh rice hull mixture (1:1), allowed to incubate for 24 hours, and spread over the plot rows while still moist.

The number of days from seeding to 50% heading for each entry was recorded when about half of the panicles in a plot had emerged from the boot. Approximately 35 days after heading, each entry was rated for sheath blight, brown spot, narrow brown spot, and leaf smut infection severity on a 0 to 9 scale previously reported.

A blast nursery was established at the Rice Research Station in 1987. The facility consists of permanent concrete beds 50 ft long and 3.5 ft wide. In these beds a mixture of soil:sand:peat moss was placed in the ratio of 1:1:1. The blast nursery was planted using three grams of seed of each entry drill seeded into a 3 ft row. A spreader block was established 2 wk before planting and inoculated with races IC-17, IB-49, IB-1, and IB-45 to serve as a source of inoculum. Row spacing was 4 inches. Spreader rows of M201 rice were planted at the end of the rows and along the edge. The beds were fertilized at 200-0-0 (N, P₂O₅, K₂O) N/A rate and sprinklers turned on to provide optimum disease conditions.

RESULTS AND DISCUSSION

1987 Disease Nurseries. In the Uniform Rice Nursery, 17 lines, entries 17, 64, 70, 77, 79, 173, 197, 199, 200, 218, 220, 228, 234, 239, 281, 282, and 339 showed a resistant (3 or less) reaction to sheath blight. Eight entries exhibited multiple disease resistance to sheath blight, brown spot (0-3), narrow brown leaf spot (0-3), and leaf smut (0-3). These were entries 17, 70, 197, 199, 200, 228, 239, and 282.

In the sheath blight nursery, disease pressure was high in severity, and any late-maturing entries were exposed to dry weather conditions during sheath blight development and their resistant reaction may have been due to these conditions. For the foliage diseases, brown leaf spot disease pressure was very light and leaf smut and narrow brown spot pressure were high in 1987.

In the blast nursery, disease pressure was very high in severity with most susceptible lines dead at the end of 4 to 6 wk. Numerous lines did show resistance to blast (0-3 rating).

MATERIALS AND METHODS

Plant Introductions. Rice germplasm is introduced through quarantine under USDA, PPQ Departmental Permit No. 59055 using the following precautionary methods. The rice seeds are selected from an apparently disease-free and pest-free source plant, securely packaged to prevent loss in transit and mailed to the Plant Germplasm Quarantine Center at Beltsville, Maryland using a green and yellow permit label. Only the minimum amount of seed needed for research purposes may be introduced and other materials are denied entry. A phytosanitary certificate issued by the plant protection service of the exporting country should accompany the seed and no fungicidal or insecticidal compounds are to be applied to the seed. At the quarantine center the seeds are visually inspected for the presence of any pests and then subject to hot water treatment at 56°C for 15 min to kill any pathogens in and on the seed. The seeds are dried and sent to the Rice Research Station in Crowley, Louisiana.

In the laboratory, under aseptic conditions, the hulls are removed and the seeds are surface sterilized in 1% NaHO (20% bleach) for 1 to 2 hours. Seeds are then germinated using standard seed health testing methods. This involves placing the surface sterilized seed on plates of potato dextrose agar (PDA, Difco), sealing the plates with parafilm and incubating them under cool-white fluorescence lamps for 7 to 10 days at room temperature ($20^{\circ}\text{C} \pm 2$). This allows the seeds to germinate and any fungal or bacterial pathogens to grow out from the seed onto the agar and be detected. Individual uncontaminated, normal seedlings are potted in soil in the greenhouse. Hulls, contaminated seedlings, agar plates and any other plant materials not used are sterilized by autoclaving (1 hr at 15 lb pressure).

In the greenhouse, the rice plants are fertilized, treated with carbofuran, and a permanent flood is established. Plants are inspected periodically for any evidence of disease. Any diseased plants are immediately rouged and destroyed by incineration. In addition, the plants and greenhouse are sprayed weekly with pesticides to control potential insect vectors. Seeds produced on the quarantined mother plants are heat treated for 24 hrs at 50°C and, after visual inspection, released. All vegetative parts of the mother plants are destroyed by incineration and the water in the greenhouse bench is treated by adding chlorine bleach.

The plant introductions from 1986 were planted in 1987. Three grams of seed of each entry were drill seeded into a 3-ft row. Row spacing was 10 inches with 3 ft between tiers of rows with one row of variety Lemont between two rows of introductions.

All plots in the nursery were inoculated with a rice seed: rice hull:fungus inoculum at a rate of 50 ml/2 row plot. Inoculum was prepared by inoculating a moist, autoclaved (1 hr at 15 lb pressure on 2 consecutive days) rice grain:rice hull medium (1:2), in 2 liter flasks, with plugs from a 5-day old PDA culture. The inoculum was incubated at 28°C for 14 days with daily

shaking. After incubation, the inoculum was removed from the flasks, broken into small pieces, mixed with moist rice hulls (1:1) and spread over the plot rows while still moist.

Approximately 35 days after heading, each entry was rated for sheath blight infection severity on a 0 to 9 scale previously reported. Grain type and plant height were recorded for each entry. Disease reactions to naturally occurring brown spot, leaf smut, and narrow brown leaf spot were made for each line using 0 to 9 scales. Plant height and grain type were recorded for each entry.

RESULTS AND DISCUSSION

1986 Plant Introductions. Approximately 46 new rice lines were introduced through plant quarantine in 1987 (Table 1). Seed of each line will be increased in 1988 and be deposited in the National Small-grains Collection at Beltsville, Maryland where it will be made available some time in 1989. In addition, all lines will be screened for various characteristics, including disease resistance, insect resistance, and other agronomic traits.

Results of 1986 introductions germplasm evaluations are presented in Table 2. Numerous lines showed good resistance to sheath blight, leaf smut, brown spot, and narrow brown spot. Further evaluations will be conducted.

Table 1. Plant introductions at the Rice Research Station, Crowley, LA. 1987.

Introduction number	Oryza species	Identification number	Source
DG870430	<i>O. tisseranti</i>	W1345	Guinea
431	<i>O. tisseranti</i>	W1620	Cameroon
433	<i>O. malampuzhaensis</i>	W1159	India
438	<i>O. latifolia</i>	W1172	Guatemala
439	"	W1178	Costa Rica
441	"	W1539	Argentina
443	"	1184	Surinam
444	"	W1174	Guatemala
446	"	W1176	Guatemala
447	"	W1177	Costa Rica
448	"	W1180	Costa Rica
470	<i>O. brachyantha</i>	W1405	Mali
471	"	W1404	Sierra Leone
472	"	W1407	Mali
473	"	W1401	Sierra Leone
474	"	W1712	Cameroon
475	"	W1708	Cameroon
476	"	W1703	Mali
477	"	W1057	Guinea
480	"	W0656	Guinea
492	<i>O. longiglumis</i>	W1218	Dutch New Guinea
495	<i>O. australiensis</i>	W1639	Australia
498	"	W1562	Australia
500	"	W1630	Australia
531	<i>O. punctata</i>	W1592	Cameroon
532	"	W1582	Chad
535	"	W1586	Chad
538	"	W1409	Nigeria
542	"	W1514	Kenya
544	"	W1593	Nigeria
546	<i>O. minuta</i>	W0051	Unknown
555	<i>O. barthii</i>	W1435	Mali
556	"	W1436	Mali
558	"	W1433	Mali
561	"	W1416	Sierra Leone
565	"	W1417	Sierra Leone
567	"	W1407	Mali
568	"	W1434	Mali
577	"	W1629	Australia
579	"	W1633	"
582	"	W1636	"
583	"	W1634	"
584	"	W1635	"
621	<i>O. perennis</i>	W1479	Brazil
627	<i>O. perennis</i>	W1714	Brazil

Table 2. Agronomic and disease resistance traits of 1986 plant introduction tested in 1987 at the Rice Research Station, Crowley, LA. 1987.

	Variety name	PI number	Grain type	Height (cm)	Sheath blight (0-9)	Brown spot	Leaf smut	Narrow brown leaf spot
DG860404	Akiahikari	PI514651	Medium	95	3	4	4	0
405	Akinishiki	PI514652	"	97	2	4	1	0
406	Akiyutaka	PI514653	"	95	3	5	4	0
407	Aoisora	PI514654	"	90	6	4	0	0
408	Chiyonishiki	PI514655	"	95	4	5	1	3
409	Fukuhikari	PI514656	"	95	3	0	4	4
411	Hounenwase	PI514657	"	100	7	6	3	2
412	Hourei	PI514658	"	95	5	2	3	0
413	Kiyonishiki	PI514659	"	90	6	5	2	2
414	Kochihibiki	PI514660	"	85	2	3	0	0
416	Koshihikari	PI514661	"	97	4	3	1	2
418	Natsuhikari	PI514662	"	95	5	3	5	3
419	Nipponbare	PI514663	"	100	3	3	0	0
421	Oozara	PI514664	"	100	5	2	2	3
423	Reimei (induced mutant)	PI514665	"	100	7	0	4	0
424	Sachiminori	PI514666	"	95	5	3	0	3
425	Sasanishiki	PI514667	"	95	7	3	6	1
426	Todorokiwase	PI514668	"	90	6	3	4	0
427	Toyamanishiki	PI514669	"	95	7	3	4	4
DG860428	Toyonishiki	PI514670	"	100	6	2	3	0
Lemont Std.			Long	85	8	5	5	6

EFFECTS OF SHEATH BLIGHT ON RICE RATOON DEVELOPMENT FOR CRAWFISH FORAGE

D.E. Groth and M.W. Brunson

Location: Rice Research Station, Crowley, LA

Soil Type: Crowley silt loam

Variety/Seed Rate: Lemont, Leah, Mars, Tebonnet, 100 lb/A

Planting Method/Date: Drill seeded - Apr 8, 1987

Fertilization: 75-75-75, Apr 8, 100-0-0, May 6

Second Crop: 45-0-0, Aug 20

Plot Size: 4 x 16 ft

Water Management: Flushed Apr 9, Apr 16, Apr 21, Apr 27, Apr 29; Permanent flood May 7, Drained July 27, Ratoon flood Aug 21

Herbicides: 4 qt/A propanil

Insecticides: 14 lb/A Furadan, May 27

Fungicide: NTN 19701 0.5 lb/A applied to the uninoculated check with a CO₂ backpack sprayer

Harvest: Grain Aug 6; second crop forage Nov 11
Yields calculated at 12% moisture

Experimental Design: Randomized block design with four replications

Disease Ratings: Sheath blight severity (0-9 scale) Aug 10,
Infestation level (0-100%) July 21,
Stand counts (tillers per foot of row) Oct 23

Inoculations: Sheath blight inoculum applied in 0, 25, 50, 75, 100, 125, and 150 ml to plots on Jun 3

Results: Table 1.

Comments: Reduction in sheath blight development and percent tillers infected increased first crop grain yields, second crop stand count, and forage yields. Mars was the best variety for grain and forage yields. This was due to good tillering and resistance to sheath blight which reduced damage to the tillers.

Table 1. Effect of sheath blight development and infestation on first crop yield, tillering, and forage for crawfish. Rice Research Station, Crowley, LA. 1987.

Variety	Sheath blight inoculum	First crop			Second crop	
		Sheath blight rating	Percent tillers infected	Grain yield (lb/A)	Stand count	Forage yield (lb/A)
Lemont	0	2.3	27	7235	16	4049
	25	7.3	62	6428	3	2335
	50	6.6	76	6094	13	2534
	75	7.0	88	6391	6	2644
	100	7.0	89	6339	7	2798
	125	7.3	100	5720	9	2747
	150	6.0	71	6181	6	1786
Leah	0	3.7	17	7341	15	4309
	25	3.3	55	7014	8	3056
	50	3.3	17	6943	10	3348
	75	4.1	60	6697	13	2747
	100	4.3	63	7379	15	3502
	125	4.7	79	7019	10	3725
	150	3.7	49	6734	9	3210
Mars	0	3.0	1	7702	12	5613
	25	3.7	22	7793	13	4326
	50	4.3	18	7528	15	5373
	75	3.7	27	7206	8	3571
	100	4.3	40	7350	15	4566
	125	4.0	43	7736	9	3708
	150	3.3	27	7793	13	4584
Tebonnet	0	4.0	12	7490	10	3330
	25	7.7	50	6833	3	2421
	50	6.0	48	6756	2	2026
	75	8.3	60	6777	4	2420
	100	8.3	56	6131	3	2678
	125	7.3	73	6165	2	1123
	150	7.0	56	5161	4	4240
LSD (P=0.05)		1.8	34	788	6	1848

OFF-STATION COMMERCIAL RICE FUNGICIDE TRIAL^{1/}

D.E. Groth

Location: Errol Lounsberry Farm, Lake Arthur, LA (Vermilion Parish)

Soil Type: silt loam

Variety/Seed Rate: Lemont, 130 lb/A

Planting Method/Date: Water seeded, Apr 7, 1987

Fertilization: 70-0-0 PPI; 36-0-0, May 31 (green ring)

Second Crop: 45-0-0

Plot Size: 6 x 20 ft

Water Management: Permanent flood, Apr 16; drained, July 25; ratoon flood,
Aug 14

Herbicides: 4 pts Bolero PPI; 2 pt Basagran, May 23; 3 pt 2,4-D, May 30

Insecticides: 17 lb/A Furadan, May 15

Fungicides: Various fungicides, rates and timing -- See Table 1

Dates of Applications: June 13 [panicle differentiation (PD)], June 22 [Boot
(B)], and July 1 [Heading (H)]

Application Equipment: CO₂ backpack sprayer, 8002 tips, 20 gal/A

Harvest: Aug 12; second crop Nov 12

Experimental Design: Randomized block design with four replications

Disease Ratings: Sheath blight severity (0-9 scale) July 17;
Infestation levels (0-100%) Aug 1

Results: First and second crop results - Table 1

Comments: Sheath blight severity was moderate, other diseases were low.
Fungicides were applied to 1st crop only; effects on 2nd crop were residual.

^{1/} This research is supported in part by funds provided by rice producers through the Louisiana Rice Research Board.

Table 1. Results of off-station fungicide trial, Lake Arthur, LA. 1987.

Treatment	Timing	Rate formulated/A	Sheath blight		Yield lb/A	Change lb/A	Yield 2nd lb/A	Change	Total yield change
			Rating	Infestation					
Untreated check	--	--	7	63	4229	---	577	---	---
Benlate 50 WP	PD + B	1 lb	5*	40*	4506	277	1058	473	750
Benlate 50 WP	B + H	1 lb	4*	35*	4747	518	829	252	770
Benlate + CS7	B + H	1 lb	5*	35*	5239*	1010	669	92	1102
Foliatec	B + H	12 oz	6	57	4546	317	557	-20	297
Rovral 50 WP	PD + B	1 lb	7	60	4618	389	780	203	592
Rovral 50 WP	B + H	1 lb	6	58	4846*	617	785	208	825
Rovral + CS7	B + H	1 lb	5*	55	4192	-37	1075	499	462
Rovral 50 WP	PD + B + H	0.66 lb	6	35*	5156*	927	701	124	1051
Tilt 3.6 EC	PD + B	6 oz	4*	25*	5143*	914	944	367	1281
Tilt 36 EC/Benlate	B/H	10 oz/1 lb	4*	48	4657	428	883	306	734
NTN19701 75 WP	PD + B	0.33 lb	5*	35*	4843*	614	1050	473	1087
SN84364 50 WP	PD + B	0.5 lb	5*	42*	4763	534	1001	424	958
SN84364/Benlate	B/H	0.5 lb/1.0 lb	6	45	4753	524	895	318	842
LSD = 0.05			2.0	2.1	543			301	

COMMERCIAL RICE FUNGICIDE TRIAL^{1/}

D.E. Groth

Location: Rice Research Station, Crowley, LA

Soil Type: Crowley silt loam

Variety/Seed Rate: Lemont, 100 lb/A

Planting Method/Date: Drill seeded - Apr 28, 1987

Fertilization: 60-60-60, Apr 27; 60-0-0, May 19; 21-0-0, June 25

Plot Size: 4 x 16 ft

Emergence Date: May 4

Water Management: Flushed Apr 29, Permanent flood May 19, Drained Aug 10

Herbicides: 4 qt/A propanil, May 14

Insecticides: 20 lb/A Furadan, June 16; Seven XLR 1.3 qt/A, July 17

Fungicides: Various fungicides, rates and timing -- See Table 1.

Application Equipment: CO₂ backpack sprayer, 8002 tips, 20 gal/A

Harvest: Aug 19

Experimental Design: Randomized block design with four replications

Disease Ratings: Sheath blight severity (0-9 scale) July 17, Aug 18;
Infestation levels (0-100%) Aug 18; Brown spot, leaf smut,
and narrow brown leaf spot (0-9 scales) Aug 18

Results: Table 1.

Comments: Sheath blight severity was high, other diseases were moderate.

^{1/} This research is supported in part by funds provided by rice producers through the Louisiana Rice Research Board.

Table 1. Effects of foliar fungicides on second rice disease and yields. Rice Research Station, Crowley, LA. 1987.

Treatment number	Fungicide treatment	Timing	Rate formulated	Sheath blight			NB	LFSC	Yield	Change
				7/17/87	8/17/87	Percent				
1	Uninoculated check	---	---	1.3	4.5	38	4.3	10.0	7623	1045*
2	Inoculated check	---	---	5.3	7.5	80	5.0	12.6	6578	---
3	Benlate 50WP	B + H	1 lb	3.3	5.8	61	2.3	5.3	7143	565*
4	"	B + H	2 lb	3.8	4.3	40	2.0	6.3	7303	725*
5	"	PI + B	1 lb	4.0	5.5	57	2.3	10.0	6860	282
6	"	B	1 lb	3.5	6.8	62	2.8	10.0	7378	800*
7	"	H	1 lb	4.8	7.0	69	2.0	7.6	7346	768*
8	"	H	1 1/2 lb	4.5	6.0	58	3.0	7.8	7157	579*
9	"	H	2 lb	4.0	5.0	43	2.5	6.3	7566	988*
10	Benlate 50WP + CS7	B + H	1 lb	2.8	7.0	62	2.5	10.0	7469	891*
11	Foliatec 3.8 FL	PI + B	12 fl oz	3.8	7.3	74	3.5	11.3	6618	40
12	Foliatec	B + H	12 fl oz	3.8	7.3	74	3.5	12.6	7007	429
13	Rovral 50WP	B + H	1 lb	4.8	4.5	43	3.0	10.0	7266	688*
14	"	B + H	2 lb	4.0	2.8	14	2.8	10.0	7466	888*
15	"	PI + B	1 lb	2.8	5.8	50	3.3	11.3	7307	729*
16	"	B	1 lb	3.8	6.0	53	3.0	10.0	7071	493
17	"	H	1 lb	4.8	4.8	43	2.8	11.3	7307	729*
18	"	H	1 1/2 lb	5.0	4.3	28	3.3	10.0	7216	638*
19	"	H	2 lb	4.8	3.5	30	2.3	10.0	7446	868*
20	Rovral 50WP + CS7	B + H	1 lb	3.0	3.8	29	3.3	10.0	7357	779*
21	Rovral/Benlate	B/H	1 lb/1 lb	4.0	6.5	60	2.8	8.8	7317	739*
22	Rovral Flo	B + H	0.5 lb AI/Ac	3.5	3.8	27	3.0	11.3	7333	755*
23	Tilt 3.6 EC	PI + B	6 fl oz	2.5	4.3	39	0.3	2.0	8.8	7273
24	"	PI + B	8 fl oz	3.3	4.5	35	0.5	2.5	8.8	7752
25	"	B	6 fl oz	5.0	5.3	44	0.8	2.3	11.3	7303
26	"	B	8 fl oz	4.5	4.5	44	0.5	2.3	10.0	7080
27	"	B	10 fl oz	3.5	4.3	42	0.8	2.3	11.3	7444
28	Tilt/Benlate	B/H	8 fl oz/1 lb	3.5	4.8	35	0.5	1.3	8.8	7501
29	Tilt + CS7	PI + B	6 fl oz	3.5	4.5	38	0.3	2.3	11.3	7130
30	SN84364 50WP	PI + B	0.5 lb	3.5	4.5	39	3.0	3.5	11.3	7281
31	"	PI + B	0.7 lb	3.0	4.3	39	2.8	4.5	10.0	7871
32	"	PI + B	1.0 lb	3.3	3.8	37	2.5	3.5	10.0	7540
33	SN84364 50WP + CS7	PI + B	0.7 lb	3.3	4.3	39	3.0	3.5	11.3	7177
34	SN/Benlate	B/H	0.7 lb/1 lb	3.5	4.3	39	3.3	3.5	10.0	7494
35	NTN19701 75WP	B + H	0.33 lb	4.0	2.5	14	3.8	4.5	10.0	7660
36	NTN19701	B + H	0.70 lb	4.3	2.8	20	3.3	3.8	10.0	7743
37	NTN/Benlate	B/H	0.7 lb/1 lb	4.3	2.8	17	3.8	3.3	10.0	7190
38	NTN19701	PI + B	0.7 lb	2.3	2.5	13	3.5	4.3	10.0	7584
39	Rovral	PI + B + B	2/3 lb	2.8	5.3	47	4.0	4.3	13.8	7349
40	Dithane	B + H	3 lb	3.3	6.3	55	1.0	3.3	11.3	7102
41	Dithane	B + H	5 lb	3.5	5.5	53	0.3	2.8	8.8	7121
42	SN84364 20 FL	PI + B	1.8 lb	2.8	6.0	53	2.5	4.8	10.0	7094
43	Rovral + Ortho 77	---	1 lb 1 qt/100 gal	3.8	3.3	22	4.0	4.8	10.0	7185
44	Foliatec 3.8 FL + CS7	---	12 fl oz + 1 qt/100 gal	3.3	6.8	67	4.0	4.3	10.0	6292
LSD (0.05)				1.3	1.3	16	1.3	0.9	4.0	545

WHEAT FUNGICIDE TRIAL

D.E. Groth

Location: Rice Research Station, Crowley, LA

Soil Type: Crowley silt loam

Variety/Seeding Rate: McNair 1003, Coker 762, and Florida 302, 100 lb/A

Planting Method/Date: Drill seeded, Nov 18, 1986

Fertilization: 25 lb N/A preplant, 75 lb N stage 5, Feb 18, 1987

Plot Size: 4 x 20 ft

Herbicide: None

Insecticide: None

Fungicide: Various rates, timings, and kinds (See Table 1);
Stage 9, only Mar 20, 1987

Application Equipment: CO₂ backpack sprayer, 1102 tips, 20 gal/A,
30² lb/in² pressure

Harvest: May 29, 1987

Experimental Design: Randomized complete block design with four replications

Disease Ratings: Leaf rust (0-9), Strip rust (0-9)

Comments: Disease pressure was low in 1987. Weather conditions turned dry after first application and second applications were eliminated. All fungicides were effective in controlling leaf and stripe rust. No phytotoxicity was observed.

Table 1. Results of wheat fungicide trial, Rice Research Station, Crowley, LA. 1987.

Cultivar, treatment, and rate/A	Leaf rust	Stripe rust	Test wt. (lb/bu)	Yield (lb/A)
<u>McNair 1003</u>				
Control	3.3		56.2	3161
Dithane M45 2 lb.	2.0		55.0	3228
Dithane M45 2 lb + CS7 16 oz/100 gal.	1.8		57.3	3463
Bayleton 50 Bayleton 4 oz	2.0		57.7	3308
Bayleton 50 WP 4 oz + CS7 16 oz/100 gal	1.5		58.2	3468
Dithane 78 32 oz.	1.0		57.1	3552
Dithane 78 32 oz + CS7 16 oz/100 gal.	1.0		56.3	3287
Tilt 3.6 EC 4 oz.	1.0		58.1	3254
HWG1608 12 oz	0.8		55.4	3370
HWG1608 18 oz	0.8		54.3	3208
Manzate 200 0.4 gal	1.5		56.6	3242
Manzate 200 0.4 gal + CS7 16 oz/100 gal	1.3		55.5	3274
LSD (P = 0.05)	1.0		NS	NS
<u>Coker 762</u>				
Control		4.0	52.4	2736
Dithane M45 2 lb.		2.8	54.4	3238
Dithane M45 2 lb + CS7 16 oz/100 gal.		2.8	53.1	2776
Bayleton 50 WP 4 oz		3.3	55.3	2862
Bayleton 50 WP 4 oz + CS7 16 oz/100 gal		3.0	54.1	2959
Dithane 78 32 oz.		2.8	56.4	3354
Dithane 78 32 oz + CS7 16 oz/100 gal.		3.0	53.3	2928
LSD (P = 0.05)		0.9	NS	317
<u>Florida 302</u>				
Control		0.3	57.8	3729
Dithane M45 2 lb.		0.0	56.6	3731
Dithane M45 2 lb + CS7 16 oz/100 gal.		0.0	59.3	3489
Bayleton 50 WP 4 oz		0.0	58.3	3790
Bayleton 50 WP 4 oz + CS7 16 oz/100 gal		0.0	56.4	3850
Dithane 78 32 oz.		0.0	56.1	3767
Dithane 78 32 oz + CS7 16 oz/100 gal.		0.0	54.5	3897
LSD (P = 0.05)	0.3		NS	NS

CULTURAL MANAGEMENT OF RICE DISEASES^{1/}

D.E. Groth

Location: Rice Research Station, Crowley, LA

Soil Type: Crowley silt loam

Variety/Seed Rate: Lemont, 25, 50, 100, 150, and 200 lb/A

Planting Method/Date: Drill seeded, Apr 28, 1987

Fertilization: 0, 50, 100, 150, and 200 lb N/A preflood May 25

Plot Size: 4 x 16 ft

Water Management: Flushed Apr 24, Permanent flood May 26, Drained Aug 17

Herbicides: 4 qt/A propanil, May 14

Inoculated: Jun 24, 100 ml/plot

Insecticides: 17 lb/A Furadan Jun 16; Seven XLR 1.3 qt/A Jul 17

Fungicides: None

Harvest: Aug 24

Experimental Design: Randomized block design with four replications

Data Collection: Seedling counts May 22; Sheath blight severity (0-9 scale)
Aug 15; Tiller counts Aug 28.

Results: Table 1.

Comments: Sheath blight severity was high in the inoculated plots and moderate in the uninoculated plots.

^{1/} This research is supported in part by funds provided by rice producers through the Louisiana Rice Research Board.

Table 1.

Nitrogen N rate (lb/A)	Planting rate (lb/A)	Inoculation	Plant stand (#/ft)	Tillers (#/ft)	SB rating	Yield
0	25	+	4	10	3.8	1626
0	25	-	5	11	2.3	1613
0	50	+	9	12	4.5	1829
0	50	-	8	13	4.8	1732
0	100	+	14	15	5.8	1648
0	100	-	19	14	4.8	1862
0	200	+	28	23	5.0	1482
0	200	-	23	23	5.8	1697
50	25	+	5	14	7.0	2367
50	25	-	5	15	5.0	2662
50	50	+	9	17	6.5	3053
50	50	-	8	19	5.5	3862
50	100	+	18	22	7.3	3679
50	100	-	15	24	6.5	3529
50	200	+	28	26	7.5	4680
50	200	-	24	29	4.8	4238
100	25	+	5	23	7.5	3911
100	25	-	5	19	5.5	3866
100	50	+	11	25	7.5	4184
100	50	-	9	21	5.0	5536
100	100	+	14	25	7.8	4049
100	100	-	15	21	5.3	5411
100	200	+	30	32	7.0	4929
100	200	-	29	30	6.0	5451
150	25	+	7	20	6.8	5021
150	25	-	5	25	3.8	5693
150	50	+	12	27	7.3	5705
150	50	-	8	24	4.3	5962
150	100	+	17	32	7.5	5518
150	100	-	17	32	5.0	6531
150	200	+	22	33	7.3	5616
150	200	-	25	32	4.0	6442
200	25	+	7	26	5.5	5095
200	25	-	5	28	4.3	4847
200	50	+	9	30	6.8	4627
200	50	-	12	26	6.0	4383
200	100	+	22	32	4.3	4309
200	100	-	16	27	5.5	4658
200	200	+	30	32	7.0	3737
200	200	-	29	30	5.8	3552
LSD (P=0.05)			5.2	6.5	1.7	487

FUNGICIDAL CONTROL OF RICE FOLIAR AND STEM DISEASES^{1/}

M.C. Rush, G.D. Lindberg, and D.E. Groth

INTRODUCTION

Field testing of foliar applications of fungicides for the control of diseases caused by fungi was initiated in 1972. Theoretically, the fungal diseases occurring on rice in Louisiana can be controlled by foliar applications of fungicides. The diseases which are economically significant include blast (Pyricularia oryzae), brown spot (Bipolaris oryzae), sheath blight (Rhizoctonia solani), stem rot (Sclerotium oryzae), narrow brown leaf spot (Cercospora oryzae), and leaf smut (Entyloma oryzae). These diseases are endemic in the Louisiana rice area becoming epidemic periodically. Certain of our presently grown commercial varieties are very susceptible to these diseases. Ultimately, control of these diseases will be by an integrated disease management system using a combination of pesticides, disease resistance, cultural practices, biological control, and legislative-regulatory procedures. It is important that effective fungicides are found, developed, and made available to Louisiana rice growers for use in disease management programs.

MATERIALS AND METHODS

A test was conducted at the Rice Research Station, Crowley, LA, during the 1987 season to screen fungicides for their efficacy in controlling foliar and stem diseases on Lemont rice. The tests were conducted on Crowley silt loam soil with a pH of 6.0. Plots were 20-ft, 7-row, drill strips with 7-inch row spacing and 14-inch alleys. Each treatment was replicated five times using a randomized complete block design. The plots in this test were inoculated with Rhizoctonia solani as previously described (2) and infections by the target fungi were from this inoculation or from natural sources of inoculum. Six hundred lb/A of 20-10-10 fertilizer was applied by a drill application to the test area at planting. Plots were planted April 29, and 4 lb/A of propanil was applied over the test area before applying the permanent flood. Fungicide applications were made at the green ring (June 22), early boot (July 4), and heading (July 27) stages of growth. Fungicides were applied in 20 gal/A of water with a backpack type CO₂ sprayer. The treatments were as indicated in Table 1.

Plots were rated for sheath blight, brown spot, narrow-brown spot, and leaf smut incidence 2 days before harvest. A 30-40 tiller sample was cut from each plot at this time and frozen for later evaluation for stem rot. Rating systems for the foliar diseases (1) and for stem rot (2) were previously reported. The plots were harvested with a small-plot combine on September 7. Rough rice weights were corrected to 12% moisture.

^{1/} Mention of trade names of the fungicides or other chemicals described in this report are for identification purposes only and does not imply endorsement by the Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center.

RESULTS AND DISCUSSION

There was a 670 lb/A difference in yield between the uninoculated plots and the inoculated, unsprayed control plots (Table 1). This difference was considered to be the yield loss caused by sheath blight following inoculation with *R. solani*. There was a higher than usual amount of natural sheath blight infection in 1987 because of the unusually high rainfall in June. Twenty-eight and a half percent of the uninoculated tillers were infected compared to 82.4% of the inoculated tillers at heading. The mean percentage of tillers infected at maturity had increased to 65.8% in the uninoculated plots and 84% in the inoculated plots. Although significantly fewer tillers were infected in the uninoculated plots, there was enough disease to reduce the normal difference between the "healthy" and infected plots which is usually around 1000 lb/A.

Six of 38 fungicidal treatments gave significant yield increases over the inoculated, unsprayed control. The increases ranged from 1058 to 1310 lb/A. Significant yield increases, as indicated in Table 1, were given by Folicur 1.2E (1310 lb/A), Uniroyal C2338 10% EC (1206 lb/A) ICI United States PP523 0.5 Sc (1184 lb/A), Rovral 50wp + Benlate 50wp (1107 lb/A), Benlate 50wp + HB7923 (1058 lb/A), and Moncut (Nor-Am SN84364 20F1) (1038 lb/A).

Fifteen of 38 treatments significantly reduced the number of tillers infected at the heading stage of growth. Treatments with the lowest percentage of tillers infected at heading all had a green-ring stage fungicide application. Monceren 75wp, FBC39865 25wp, PP523 0.5 Sc, and RH-3486 50wp gave the greatest early sheath blight reduction. Twenty-six of 38 fungicide treatments gave significant reductions in the number of tillers infected at maturity (Table 1). Thirty-two of 38 treatments had significantly fewer tillers dead at maturity than the inoculated control. The outstanding treatments included Rovral 4F, Rovral 50wp, Rovral 50wp + Benlate 50wp, Uniroyal C2338 10% EC, Folicur 1.2E, Monceren 75wp, Monceren 75wp followed by Benlate 50wp, Monceren 75wp followed by Folicur 1.2E, Tilt 3.6E followed by Benlate 50wp, SN84364 50wp (Moncut) followed by Benlate 50wp, SN84364 20F1, FBC39865 25wp, PP523 0.5 Sc, RH-3486 50wp, and Benlate 50wp + HB8584.

The HB compounds used with Benlate 50wp were spreader-sticker materials from Helena Chemical Co. The FBC39865 25wp compound was from Nor-Am Chemical Co. The Rohm and Haas compound RH-3486 50wp gave excellent control of sheath blight, but yields were not increased or decreased from the control at the higher rate (Table 1). Although no obvious symptoms of phytotoxicity were observed, it appears that this compound had deleterious effects on the sprayed plants at the rates used in this test.

Thirty-four of the 38 fungicide treatments used in this test gave significant control of narrow-brown leaf spot (Table 2). Disease pressure from natural infection was moderately high in this test. Folicur 1.2E gave the best control of NBLs. Rovral 50wp and Rovral 4F gave the poorest control of this disease.

The incidence of brown spot was low in 1987. Folicur 1.2E and Monceren 75wp at boot followed by Benlate 50wp at heading gave significant control of the disease (Table 2). Leaf smut incidence was moderate in 1987 (Table 2). Twenty of 38 fungicide treatments significantly reduced leaf smut. The

Table 1. Effects of foliar fungicides on sheath blight control and yield. Rice Research Station; Crowley, LA

Treatment	Rate (formulated/A)	Timing	Yield (lb/A)	Mean $\frac{a}{b}$ % tillers infected at heading	Mean $\frac{a}{b}$ disease rating at heading	Mean $\frac{a}{b}$ % tillers infected at maturity	Mean $\frac{a}{b}$ % tillers dead at maturity	Mean $\frac{a}{b}$ disease rating at maturity
1. Uninoculated-unsprayed control			5210	28.5**	1.3**	65.8*	21.0**	4.6**
2. Inoculated-unsprayed control			4540	82.4	3.4	84.0	51.0	6.6
3. Benlate 50wp	1 lb	B,H	4930	72.6	2.4	64.8*	30.0*	5.8
4. Rovral 50wp	1 lb	B,H	5305	75.6	2.6	63.0*	20.0**	5.8
5. Rovral 4F	1 pt	B,H	4496	59.6*	2.8	43.4**	7.5**	3.6**
6. Rovral 50wp	1 lb	GR,B	5267	83.2	2.8	90.6	69.0	8.0
7. Rovral 50wp and Benlate 50wp	1 lb 1 lb	B H	4854	67.2	2.0**	63.4*	24.0**	4.6**
8. Rovral 50wp + Benlate 50wp	0.5 + 0.5 lb	B,H	5647*	70.4	2.2*	50.4**	18.5**	4.4**
9. Uniroyal C2338 10% EC	1.25 pt	B,H	4984	75.2	3.2	65.0*	14.0**	3.8**
10. Uniroyal C2338 10% EC	2.5 pt	GR,B	5106	72.8	3.0	73.0	35.0	5.6
11. Uniroyal C2338 10% EC	2.5 pt	B,H	5231	71.0	2.5	43.2**	7.9**	3.0**
12. Uniroyal C2338 10% EC	3.75 pt	B,H	5427	68.0	2.6	43.2**	14.2**	3.8**
13. Uniroyal C2338 10% EC	3.75 pt	GR,B	5746*	58.4	2.2*	71.8	27.0**	5.4
14. Uniroyal C2338 10% EC	5.0 pt	B,H	4980	70.8	2.4	51.4**	11.5**	3.6**

Continued.

Table 1. (Cont'd)

Treatment	Rate (formulated/A)	Timing	Yield (lb/A)	Mean $\frac{a}{b}$ % tillers infected at heading	Mean $\frac{a}{b}$ disease rating at heading	Mean $\frac{a}{b}$ % tillers infected at maturity	Mean $\frac{a}{b}$ % tillers dead at maturity	Mean $\frac{a}{b}$ disease rating at maturity
15. Follicur 1.2E (HWG 1608)	0.75 pt	B, H	5457	72.6	2.8	69.4	29.2*	5.0*
16. Follicur 1.2E	1.2 pt	B, H	4996	62.4*	2.8	54.8**	11.7**	3.6**
17. Follicur 1.2E	1.5 pt	B, H	5850*	75.6	3.0	44.6**	4.3**	2.6**
18. Monceren 75wp	0.33 lb	GR, B	5411	17.6**	0.6**	26.0**	2.7**	2.6**
19. Monceren 75wp	0.33 lb	B, H	4954	80.4	2.6	34.6**	4.0**	3.0**
20. Monceren 75wp + Benlate 50wp	0.33 lb 1.0 lb	B H	4127	54.2*	2.3*	35.8**	1.2**	2.2**
21. Monceren 75wp + Follicur 1.2E	0.33 lb + 0.75 pt	B, H	5006	55.6	1.3**	26.6**	1.0**	2.0**
22. Tilt 3.6E	0.375 pt	GR, B	5449	62.4	1.5**	68.6	44.0	5.8
23. Tilt 3.6E	0.63 pt	GR, B	5486	62.2	2.6	76.8	36.0	5.8
24. Tilt 3.6E + Benlate 50wp	0.63 pt 1 lb	GR, B H	5244	81.6	2.8	55.8**	11.0**	4.0**
25. SN 84364 50wp	0.7 lb	GR, B	5234	43.8**	1.6**	78.4	34.0	5.8
26. SN 84364 50wp + Benlate 50wp	0.7 lb 1.0	B H	5080	65.6	2.2*	53.4**	11.2**	3.6**
27. SN 84364 20FL	1.7 pt	GR, B	5578*	34.2**	0.6**	40.8**	6.2**	3.2**

Continued.

Table 1. (Cont'd)

Treatment	Rate (formulated/A)	Timing	Yield (lb/A)	Mean $\frac{a}{b}$ % tillers infected at heading	Mean $\frac{a}{b}$ disease rating at heading	Mean $\frac{a}{b}$ % tillers infected at maturity	Mean $\frac{a}{b}$ % tillers dead at maturity	Mean $\frac{a}{b}$ disease rating at maturity
28. FBC 39865 25wp Triton CS-7	2 lb	GR, B	4860	42.2**	1.1**	54.2**	19.5**	4.4**
29. PP 523 0.5 Sc + Triton CS-7	1.0 pt + 4 ml/gal	GR, B	5724*	56.8*	2.0**	62.4*	25.0**	5.0*
30. PP 523 0.5 Sc + Triton CS-7	6.4 pt + 4 ml/gal	GR, B	4641	23.8**	1.0**	37.4**	5.4**	2.6**
31. RH-7592 2F + Triton CS-7	0.5 pt + 4 ml/gal	GR, B	5077	70.4	2.8	71.8	21.5**	4.4**
32. RH-7592 2F + Triton CS-7	1 pt + 4 ml/gal	GR, B	5372	52.0*	2.2*	58.2**	24.0**	4.8*
33. RH-3486 50wp + Triton CS-7	1 lb + 4 ml/gal	GR, B	4851	17.8**	0.7**	41.8**	9.6**	3.2**
34. RH-3486 50wp + Triton CS-7	2 lb + 4 ml/gal	GR, B	4396	6.2**	0.4**	16.0**	0.9**	2.2**
35. Dithane F-45 + Triton CS-7	9.5 pt + 4 ml/gal	GR, B	4437	69.6	2.0**	86.0	59.0	7.2
36. Benlate 50wp + HB 7923	1 lb + 1 pt	B, H	5598*	58.4*	2.4	73.2	31.0*	5.8
37. Benlate 50wp + HB 8584	1 lb + 1 pt	B, H	5206	59.0*	2.4	64.2*	16.0**	3.8**

Continued.

Table 1. (Cont'd)

Treatment	Rate (formulated/A)	Timing	Yield (lb/A)	Mean $\bar{a}$ / % tillers infected at heading	Mean $\bar{a}$ / disease rating at heading	Mean $\bar{a}$ / % tillers infected at maturity	Mean $\bar{a}$ / % tillers dead at maturity	Mean $\bar{a}$ / disease rating at maturity
38. Benlate 50wp + HB 8595	1 lb + 1 pt	B,H	5049	59.0*	2.8	62.4*	24.5**	4.8
39. Benlate 50wp + HB 8596	1 lb + 1 pt	B,H	4119	78.4	3.6	70.0	23.0**	5.2
40. Benlate 50wp + HB 8598	1 lb + 1 pt	B,H	4711	71.2	2.8	61.8*	21.0**	4.4**
LSD 0.01 0.05			NS 1035	28.3 21.5	1.4 1.1	24.1 18.2	23.4 17.7	2.0 1.5

$\bar{a}$ / Means marked with asterisks were significantly different at the 0.01 (**) or 0.05 (*) levels.

Table 2. Effects of foliar fungicides on control of narrow brown leaf spot, brown spot, and leaf smut. Rice Research Station, Crowley, LA. 1987.

Treatment	Rate (formulated/A)	Timing	Mean disease rating NBLS (<u>Cercospora</u> <u>oryzae</u>)	Mean disease rating BS (<u>Bipolaris</u> <u>oryzae</u>)	Mean disease rating LS (<u>Entyloma</u> <u>oryzae</u>)
1. Uninoculated-unsprayed control			7.0	3.0	5.0
2. Inoculated-unsprayed control			7.2	2.8	5.4
3. Benlate 50wp	1 lb	B,H	4.4*	2.0	5.4
4. Rovral 50wp	1 lb	B,H	6.0	2.2	6.0
5. Rovral 4F	1 pt	B,H	6.0	2.6	5.6
6. Rovral 50wp	1 lb	GR,B	6.0	2.8	7.0
7. Rovral 50wp and Benlate 50wp	1 lb 1 lb	B H	5.8*	2.4	4.8
8. Rovral 50wp + Benlate 50wp	0.5 + 0.5 lb	B,H	5.6*	1.8	5.0
9. C2338 10% EC	1.25 pt	B,H	5.0*	2.4	2.6*
10. C2338 10% EC	2.5 pt	GR,B	5.6*	2.2	2.2*
11. C2338 10% EC	2.5 pt	B,H	3.6*	2.0	0 *
12. C2338 10% EC	3.75 pt	B,H	3.6*	1.8	0 *
13. C2338 10% EC	3.75 pt	GR,B	5.8*	2.2	1.4*

Continued.

Table 2. (Cont'd)

Treatment	Rate (formulated/A)	Timing	Mean disease rating NBS (<u>Cercospora</u> <u>oryzae</u>)	Mean disease rating BS (<u>Bipolaris</u> <u>oryzae</u>)	Mean disease rating LS (<u>Entyloma</u> <u>oryzae</u>)
14. C2338 10% EC	5.0 pt	B,H	3.8*	2.2	1.0*
15. Folicur 1.2E	0.75 pt	B,H	2.8*	1.8	2.0*
16. Folicur 1.2E	1.2 pt	B,H	2.2*	1.8	0.6*
17. Folicur 1.2E	1.5 pt	B,H	1.4*	1.4*	0.4*
18. Monceren 75wp	0.33 lb	GR,E	4.6*	2.4	4.4
19. Monceren 75wp	0.33 lb	B,H	5.4*	2.2	5.2
20. Monceren 75wp + Benlate 50wp	0.33 lb 1.0 lb	B H	4.4*	1.4*	4.6
21. Monceren 75wp + Folicur 1.2E	0.33 lb + 0.75 pt	B,H	2.8*	2.4	0.4*
22. Tilt 3.6E	0.375 pt	GR,B	4.6*	2.0	0.2*
23. Tilt 3.6E	0.63 pt	GR,B	4.6*	2.4	0.8*
24. Tilt 3.6E + Benlate 50wp	0.63 pt 1 lb	GR,B H	3.8*	2.0	1.0*
25. SN 84364 50wp	0.7 lb	GR,B	5.4*	2.4	4.0

Continued.

Table 2. (Cont'd)

Treatment	Rate (formulated/A)	Timing	Mean disease rating NBS (<u>Cercospora</u> <u>oryzae</u>)	Mean disease rating BS (<u>Bipolaris</u> <u>oryzae</u>)	Mean disease rating LS (<u>Entyloma</u> <u>oryzae</u>)
26. SN 84364 50wp + Benlate 50wp	0.7 lb 1.0	B H	4.4*	2.0	4.0
27. SN 84364 20FL	1.7 pt	GR,B	6.0	2.6	4.0
28. FBC 39865 25wp	2 lb	GR,B	4.8*	2.0	0.8*
29. PP 523 0.5 sc + Triton CS-7	1.0 pt + 2 ml	GR,B	5.2*	2.4	1.2*
30. PP 523 0.5 sc + Triton CS-7	6.4 pt + 2 ml	GR,B	4.2*	2.2	0 *
31. RH-7592 2F + Triton CS-7	0.5 pt + 2 ml	GR,B	4.8*	2.6	0 *
32. RH-7592 2F + Triton CS-7	1 pt + 2 ml	GR,B	4.4*	1.8	0.8*
33. RH-3486 50wp + Triton CS-7	1 lb + 2 ml	GR,B	5.6*	2.6	1.8*
34. RH-3486 50wp + Triton CS-7	2 lb + 2 ml	GR,B	5.6*	2.2	1.6*
35. Dithane F-45 + Triton CS-7	9.5 pt + 2 ml	GR,B	4.6*	2.2	3.8

Continued.

Table 2. (Cont'd)

Treatment	Rate (formulated/A)	Timing	Mean disease rating NBS (<u>Cercospora</u> <u>oryzae</u>)	Mean disease rating BS (<u>Bipolaris</u> <u>oryzae</u>)	Mean disease rating LS (<u>Entyloma</u> <u>oryzae</u>)
36. Benlate 50wp + HB 7923	1 lb + 1 pt	B,H	4.6*	1.8	4.4
37. Benlate 50wp + AB 8584	1 lb + 1 pt	B,H	4.0*	2.0	4.2
38. Benlate 50wp + HB 8595	1 lb + 1 pt	B,H	5.0*	2.2	4.8
39. Benlate 50wp + HB 8596	1 lb + 1 pt	B,H	3.8*	1.6*	6.0
40. Benlate 50wp + HB 8598	1 lb + 1 pt	B,H	4.4*	1.6*	4.4
LSD 0.05			5.9	1.7	3.4

Uniroyal C2338 10% EC, Folicur 1.2E, Tilt 3.6E, FBC39865 25wp, PP523 0.5 Sc, and RH-75922F treatments were highly effective in reducing leaf smut.

Folicur 1.2E at 1.5 pt/A at the boot and heading stages significantly reduced all four of the major diseases in this test and gave a 1310 lb/A yield increase over the unsprayed plots. This compound has performed well over several years of testing, either alone or in combination with other fungicides. In previous tests, it was designated HWG1608 (Mobay Chemical Co.).

Stem rot evaluations were not completed in time to include them in this report. This data will be presented in the 1988 Rice Research Station Report.

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CHEMICAL CONTROL OF RICE SEEDLING DISEASES - 1987^{1/}

M. C. Rush

INTRODUCTION

Seed-rot and damping-off diseases are common in the Southern rice area causing stand reduction and irregularities in water-planted and, to a lesser extent, drill-planted rice. Losses are incurred directly through the costs of replanting and indirectly through the inefficient use of space and light in irregular stands, and by increased competition with weeds. Rice seed germination and growth of seedlings is often poor under the weather conditions normally encountered in March and early April in the Southern rice area. Considerable damage to water-planted seed is encountered under these cool weather conditions regardless of the seed treatment fungi used. The fungi causing seed rotting and water-mold in water-seeded rice include species of Achlya, Pythium, and Fusarium. Drill-seeded rice can be injured by several seedborne fungi including Helminthosporium oryzae, Curvularia lunata, Fusarium roseum, and Fusarium moniliforme.

Theoretically, seed and seedling diseases of rice can be economically controlled by seed treatment fungicides. For this reason, a program to develop more effective fungicidal seed treatments has been conducted at the LSU Rice Research Station since the early 1970's. Fungicides or formulations of fungicides are field screened in experimental tests each year. Those formulations performing well in the experimental tests are advanced to further field testing in subsequent years.

MATERIALS AND METHODS

A single lot of Lemont rice seed was treated in February and the first week in March 1987 with fungicides at the rates listed in Table 1. The formulated fungicides were placed into water (2 ml/0.25 lb seed) in glass jars, stirred with a magnetic stirrer bar until in suspension, and the suspended material was used to coat the inside of each jar. Weighed seed samples were poured into the coated jars, shaken by hand for 1 to 2 minutes, and placed onto a jar mill to revolve for 10 minutes. Treated seed were stored in heavy manila seed envelopes until planted.

Simulated water- and drill-seeded methods were used to plant treated seed at the Rice Research Station, Crowley, LA. Water-seeded tests consisted of 40 treatments with five replications of 200 presoaked seeds per plot. Seed were soaked in five volumes of tap water for 24 to 30 hours before planting. Plots consisted of cylinders 1-ft high and 2-ft in diameter made of 1/8-inch mesh hardware cloth. After planting, each cylinder was covered with 1/2-inch mesh hardware cloth to keep out birds and rats. The cylinders were arranged in a

^{1/} Mention of trade names of the seed protectant fungicides described in this paper is for identification purposes only and does not imply endorsement by the Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center.

Table 1. Treatments used in the 1987 rice seed-protectant fungicide tests.

Treatment	Rate (oz. or fl. oz./cwt)	Supplier
Untreated seeds (control)	-	-
Vitavax 200 FF	4 fl. oz./cwt	Gustafson
Vitavax 200 FF + GA	4.0 + 10 ppm	Gustafson
Vitavax 200 FF + GA	4.0 + 20 ppm	Gustafson
Vitavax 200 FF + GA + IAA	4.0 + 10 ppm + 5 ppm	Gustafson
Vitavax-Maneb FF	6.0	Gustafson
Vitavax-Maneb FF + GA	6.0 + 10 ppm	Gustafson
Vitavax-Maneb FF + GA + IAA	6.0 + 10 ppm + 5 ppm	Gustafson
Captan 400 D	3.0	Gustafson
Captan 400 D + GA	3.0 + 10 ppm	Gustafson
Captan 400 D + GA	3.0 + 20 ppm	Gustafson
Captan 400 D + GA + IAA	3.0 + 10 ppm + 5 ppm	Gustafson
Apron Fl	0.75	Gustafson
Apron Fl + GA	0.75 + 10 ppm	Gustafson
Apron Fl + GA	0.75 + 20 ppm	Gustafson
Apron Fl + GA + IAA	0.75 + 10 ppm + 5 ppm	Gustafson
C2338 50wp	0.5	Uniroyal
C2338 50wp	1.0	Uniroyal
C2338 50wp	2.0	Uniroyal
C2338 50wp	4.0	Uniroyal
C2338 50wp	6.0	Uniroyal
C2338 50wp	8.0	Uniroyal
C2338 50wp	12.0	Uniroyal
C2338 50wp	16.0	Uniroyal
C2338 50wp + GA	4.0 + 10 ppm	Uniroyal
C2338 50wp + GA + IAA	4.0 + 10 ppm + 5 ppm	Uniroyal
Gibberellic Acid (IAA)	10 ppm	Sigma
(Gibberellin, A)		
GA	20 ppm	Sigma
GA + Indole-3-Acetic Acid (IAA)	10 ppm + 5 ppm	Sigma
GA + IAA	20 ppm + 5 ppm	Sigma
Dithane F-45	3.2	Rohm & Haas
Dithane F-45	4.0	Rohm & Haas
Dithane F-45	6.0	Rohm & Haas
Dithane F-45 + GA	3.2 + 10 ppm	Rohm & Haas
Dithane F-45 + GA + IAA	3.2 + 10 ppm + 5 ppm	Rohm & Haas
Dithane F-45 + GA	6.0 + 10 ppm	Rohm & Haas
Dithane F-45 + GA + IAA	6.0 + 10 ppm + 5 ppm	Rohm & Haas
Nusan 30 Ec	1.0	Buckman
Nusan 30 Ec	1.25	Buckman
Nusan 30 Ec	1.25 + 10 ppm + 5 ppm	Buckman

completely randomized block design, 2-ft apart within blocks, with a 6-ft alley between blocks. The treated seeds were planted in 4 to 6 inches of water.

Two individually leveed plot areas were planted at each planting date using identical procedures. In one plot area, the water was removed after 3 days and the plots were flushed as needed. In the other plot area, the flood was maintained at 2 to 4 inches until 3 days before the stands were counted.

Drill-planted plots consisted of the same 40 treatments planted in single 10-ft rows with 200 seed per row. Plots were replicated five times in a randomized complete block design in each test. Rows were spaced 10 inches apart within blocks with 6-ft alleys between blocks. Seeds were planted with a drop-seeder.

Plots were flushed with water as need to provide optimum conditions for growth. Stand counts were made when seedlings within a test were at the 3-4 leaf stage (4 to 6 inches tall). Plots were sprayed with propanil (4 lb ai/A) after stand counts were made, flooded, and observed for injury from fungicide-herbicide interaction. The soil pH in these tests was 6.0.

In 1987, treatments with the growth regulators gibberellic acid (GA) and indole-3-acetic acid (IAA) were used either alone or in combination with the seed-protectant fungicides to see if seedling growth could be enhanced. This research was conducted based on data (Richard Dunand, unpublished) that suggested that GA could enhance emergence of semidwarf rice in drill-seeded plots.

RESULTS AND DISCUSSION

In the drill-seeded test (Table 2), 20 of 39 treatments gave significant increases in stand over the untreated seeds. Dithane F-45 (6 fl oz), Captan 400D + Ga + IAA, Captan 400D + GA and Vitavax 200 FF + GA increased stands by 37 to 42%. Adding GA and IAA to the fungicide treatments did not increase stands significantly over the fungicide treatments alone. The GA and GA + IAA treatments alone did not significantly increase stands.

In the water-seeded, drained and flushed test (Table 3), 12 treatments gave significant increases in stand. Dithane F-45, Vitavax 200 FF, and Captan 400D were the outstanding treatments. Adding GA or IAA did not significantly increase stands. GA at 20ppm significantly decreased stand.

In the water-seeded, continuous flood test (Table 4), seven treatments significantly increased stands. Dithane F-45, Nusan 30 Ec, and Apron flowable were the outstanding treatments. Adding GA or GA and IAA did not increase stands. The growth regulators alone decreased stand. GA + IAA (20ppm + 5ppm) significantly decreased stand.

In the water-seeded, continuous flood plots three treatments with GA had significant increases in plant height 15 days after seeding (Table 5).

Table 2. Stand counts for drill-seeded seed-protectant fungicide test conducted at the Rice Research Station, Crowley, LA in 1987; test planted 4-29-87, counted 5-26-87.

Treatment	Rate (oz. or fl. oz./cwt)	Reps					Change % from untreated
		I	II	III	IV	V	
Untreated seeds	-	52	101	117	123	103	-
Vitavax 200 FF	4.0	90	126	130	136	126	23
Vitavax 200 FF + GA	4.0 + 10 ppm	123	104	127	142	184	37
Vitavax 200 FF + GA	4.0 + 20 ppm	123	136	137	124	116	28
Vitavax 200 FF + GA + IAA	4.0 + 10 ppm + 5 ppm	118	115	136	114	119	21
Vitavax-Maneb FF	6.0	131	138	126	106	157	33
Vitavax-Maneb FF + GA	6.0 + 10 ppm	103	114	150	121	147	28
Vitavax-Maneb FF + GA + IAA	6.0 + 10 ppm + 5 ppm	118	148	131	141	142	37
Captan 400 D	3.0	138	144	125	137	113	32
Captan 400 D + GA	3.0 + 10 ppm	135	122	118	126	179	37
Captan 400 D + GA	3.0 + 20 ppm	141	153	131	104	159	39
Captan 400 D + GA + IAA	3.0 + 10 ppm + 5 ppm	128	134	143	136	145	38
Apron F1	0.75	111	119	146	143	128	30
Apron F1 + GA	0.75 + 10 ppm	103	119	121	139	103	18
Apron F1 + GA	0.75 + 20 ppm	138	135	148	131	106	33
Apron F1 + GA + IAA	0.75 + 10 ppm + 5 ppm	119	116	118	119	144	24
C2338 50wp	0.5	99	117	103	130	130	16
C2338 50wp	1.0	127	121	107	135	120	23
C2338 50wp	2.0	100	119	128	124	113	18
C2338 50wp	4.0	95	140	113	101	147	20
C2338 50wp	6.0	92	103	126	110	91	5
C2338 50wp	8.0	102	96	110	107	111	6
C2338 50wp	12.0	94	127	114	124	121	17
C2338 50wp	16.0	104	126	109	132	126	20
C2338 50wp + GA	4.0 + 10 ppm	83	136	118	119	146	21
C2338 50wp + GA + IAA	4.0 + 10 ppm + 5 ppm	93	85	135	119	116	10
GA	10 ppm	88	104	131	109	146	17
GA	20 ppm	97	122	130	94	121	14
GA + IAA	10 ppm + 5 ppm	104	131	126	83	122	14
GA + IAA	20 ppm + 5 ppm	90	139	109	85	130	11
Dithane F-45	3.2	109	124	145	126	185	39

Continued.

Table 2 (continued).

Treatment	Rate (oz. or fl. oz./cwt)	Reps					Change % from untreated
		I	II	III	IV	V	
Dithane F-45	4.0	108	75	124	95	117	103.8
Dithane F-45	6.0	133	126	145	153	149	141.2**
Dithane F-45 + GA	3.2 + 10 ppm	120	105	94	123	142	116.8
Dithane F-45 + GA + IAA	3.2 + 10 ppm + 5 ppm	117	119	132	115	137	124.0*
Dithane F-45 + GA	6.0 + 10 ppm	100	89	139	80	130	107.6
Dithane F-45 + GA + IAA	6.0 + 10 ppm + 5 ppm	133	108	108	84	121	110.8
Nusan 30 Ec	1.0	84	98	139	93	126	108.0
Nusan 30 Ec	1.25	101	101	138	106	130	115.2
Nusan 30 Ec + GA + IAA	1.25 + 10 ppm + 5 ppm	102	111	118	104	128	112.6
LSD 0.05							20.1
LSD 0.01							26.5

a/ Stand equal plants reaching permanent flood (3-4 leaf) stage from 200 seeds per plot. Means marked with asterisks were significantly increased over the control at the 0.05 (*) or 0.01 (**) level of probability.

Table 3. Stand counts for water-seed, drained seed-protectant fungicide test conducted at the Rice Research Station, Crowley, LA in 1987; test planted 4-29-87, counted 5-26-87.^a

Treatment	Rate (oz. or fl. oz./cwt)	Reps					Change % from untreated
		I	II	III	IV	V	
Untreated seeds	-	90	93	92	69	89	-
Vitavax 200 FF	4.0	129	141	114	124	109	123.4**
Vitavax 200 FF + GA	4.0 + 10 ppm	120	124	96	123	117	116.0**
Vitavax 200 FF + GA	4.1 + 20 ppm	105	113	99	87	70	94.8
Vitavax 200 FF + GA + IAA	4.0 + 10 ppm + 5 ppm	120	116	99	100	89	104.8*
Vitavax-Maneb FF	6.0	101	115	107	87	97	101.4
Vitavax-Maneb FF + GA	6.0 + 10 ppm	96	122	79	80	102	95.8
Vitavax-Maneb FF + GA + IAA	6.0 + 10 ppm + 5 ppm	100	80	101	73	66	84.0
Captan 400 D	3.0	125	132	123	120	121	124.2**
Captan 400 D + GA	3.0 + 10 ppm	121	110	106	112	96	109.0**
Captan 400 D + GA	3.0 + 20 ppm	110	92	87	98	115	100.4
Captan 400 D + GA + IAA	3.0 + 10 ppm + 5 ppm	118	118	92	79	93	100.0
Apron F1	0.75	116	123	100	91	93	104.6*
Apron F1 + GA	0.75 + 10 ppm	96	91	81	60	83	82.2
Apron F1 + GA	0.75 + 20 ppm	89	84	88	98	88	89.4
Apron F1 + GA + IAA	0.75 + 10 ppm + 5 ppm	82	92	88	96	96	90.8
C2338 50wp	0.5	62	99	96	74	81	82.4
C2338 50wp	1.0	88	119	84	91	75	91.4
C2338 50wp	2.0	91	115	94	92	87	95.8
C2338 50wp	4.0	80	100	88	72	100	88.0
C2338 50wp	6.0	94	116	98	64	106	95.6
C2338 50wp	8.0	72	105	94	96	103	94.0
C2338 50wp	12.0	84	108	79	83	111	93.0
C2338 50wp	16.0	64	95	109	103	87	91.6
C2338 50wp + GA	4.0 + 10 ppm	48	92	78	94	82	78.8
C2338 50wp + GA + IAA	4.0 + 10 ppm + 5 ppm	56	75	79	96	86	78.4
GA	10 ppm	66	74	84	63	73	72.0
GA	20 ppm	59	65	69	74	73	68.0(-)*
GA + IAA	10 ppm + 5 ppm	65	83	84	53	78	72.6
GA + IAA	20 ppm + 5 ppm	62	92	73	76	77	76.0
Dithane F-45	3.2	115	135	127	121	135	126.6**

Continued.

Table 3 (continued).

Treatment	Rate (oz. or fl. oz./cwt)	Reps				Change % from untreated
		I	II	III	IV	
Dithane F-45	4.0	125	141	106	88	109 113.8**
Dithane F-45	6.0	129	129	127	133	112 126.0**
Dithane F-45 + GA	3.2 + 10 ppm	92	123	110	101	95 104.2*
Dithane F-45 + GA + IAA	3.2 + 10 ppm + 5 ppm	111	120	109	96	109 109.0**
Dithane F-45 + GA	6.0 + 10 ppm	110	136	102	66	103 101.4
Dithane F-45 + GA + IAA	6.0 + 10 ppm + 5 ppm	96	121	104	97	88 101.2
Nusan 30 Ec	1.0	97	106	103	88	111 101.0
Nusan 30 Ec	1.25	109	125	107	94	100 107.0**
Nusan 30 Ec + GA + IAA	1.25 + 10 ppm + 5 ppm	110	93	99	120	95 103.4*
LSD 0.05						15.0
LSD 0.01						19.8

a/ Stand equal plants reaching permanent flood (3-4 leaf) stage from 200 seeds per plot. Means marked with asterisks were significantly increased over the control at the 0.05 (*) or 0.01 (**) level of probability.

Table 4. Stand counts from water-seeded, continuous flood seed-protectant fungicide test conducted at the Rice Research Station, Crowley, LA in 1987; test planted 4-29-87, counted 5-26-87.

Treatment	Rate (oz. or fl. oz./cwt)	Reps					Change % from untreated
		I	II	III	IV	V	
Untreated seeds	-	71	77	69	61	62	-
Vitavax 200 FF	4.0	84	71	76	68	63	6
Vitavax 200 FF + GA	4.0 + 10 ppm	86	70	73	66	81	11
Vitavax 200 FF + GA	4.0 + 20 ppm	66	92	57	75	67	5
Vitavax 200 FF + GA + IAA	4.0 + 10 ppm + 5 ppm	74	66	69	76	68	4
Vitavax-Maneb FF	6.0	72	100	71	54	68	7
Vitavax-Maneb FF	6.0 + 10 ppm	73	79	74	58	55	0
Vitavax-Maneb FF + GA + IAA	6.0 + 10 ppm + 5 ppm	82	79	57	63	65	2
Captan 400 D	3.0	82	82	66	56	55	0
Captan 400 D + GA	3.0 + 10 ppm	70	73	65	55	59	-5
Captan 400 D + GA	3.0 + 20 ppm	66	73	63	49	42	-14
Captan 400 D + GA + IAA	3.0 + 10 ppm + 5 ppm	60	54	66	68	60	-9
Apron F1	0.75	91	93	99	86	87	34
Apron F1 + GA	0.75 + 10 ppm	77	79	76	63	82	11
Apron F1 + GA	0.75 + 20 ppm	64	92	81	59	71	8
Apron F1 + GA + IAA	0.75 + 10 ppm + 5 ppm	92	94	84	81	82	27
C2338 50wp	0.5	79	52	67	68	59	-4
C2338 50wp	1.0	81	76	78	65	57	5
C2338 50wp	2.0	89	63	78	61	76	8
C2338 50wp	4.0	58	82	61	81	69	3
C2338 50wp	6.0	81	59	60	77	65	1
C2338 50wp	8.0	68	73	68	76	69	4
C2338 50wp	12.0	70	58	70	74	68	0
C2338 50wp	16.0	61	74	96	64	59	4
C2338 50wp + GA	4.0 + 10 ppm	58	65	51	62	63	-12
C2338 50wp + GA + IAA	4.0 + 10 ppm + 5 ppm	58	57	58	61	59	-14
GA	10 ppm	71	69	41	64	57	-11
GA	20 ppm	66	60	53	56	54	-15
GA + IAA	10 ppm + 5 ppm	41	61	54	60	64	-18
GA + IAA	20 ppm + 5 ppm	53	68	59	42	51	-20
Dithane F-45	3.2	93	78	96	81	92	29

Continued.

Table 4 (continued).

Treatment	Rate (oz. or fl. oz./cwt)	Reps					Change % from untreated
		I	II	III	IV	V	
Dithane F-45	4.0	92	91	71	68	83	81.0*
Dithane F-45	6.0	97	67	70	98	77	81.8*
Dithane F-45 + GA	3.2 + 10 ppm	98	80	84	65	60	77.4
Dithane F-45 + GA + IAA	3.2 + 10 ppm + 5 ppm	83	76	64	61	70	70.8
Dithane F-45 + GA	6.0 + 10 ppm	99	91	79	74	87	86.0**
Dithane F-45 + GA + IAA	6.0 + 10 ppm + 5 ppm	94	29	70	62	77	66.4
Nusan 30 Ec	1.0	84	95	80	88	67	82.8*
Nusan 30 Ec	1.25	91	75	87	84	92	85.8**
Nusan 30 Ec + GA + IAA	1.25 + 10 ppm + 5 ppm	90	85	65	73	69	76.4
LSD 0.05							12.4
LSD 0.01							16.4

a/ Stand equals plants reaching permanent flood (3-4 leaf) stage from 200 seeds per plot. Means marked with asterisks were significantly increased over the control at the 0.05 (*) or 0.01 (**) level of probability.

Table 5. Height measurements for rice plants in the 1987 water-seeded, continuous flood test (measured on 5-14-87).

Treatment	Rate (oz. or fl. oz./cwt)	Height			Mean height
		I	II	III	
		-----cm-----			
Untreated seeds	-	8.1	7.1	7.4	7.5
Vitavax 200 FF	4 fl. oz./cwt	8.2	7.0	7.1	7.4
Vitavax 200 FF + GA	4.0 + 10 ppm	8.4	8.1	6.5	7.7
Vitavax 200 FF + GA	4.0 + 20 ppm	8.9	7.9	7.0	7.9
Vitavax 200 FF + GA + IAA	4.0 + 10 ppm + 5 ppm	9.6	7.3	7.7	8.2
Vitavax Maneb FF	6.0	8.2	7.9	6.9	7.7
Vitavax Maneb FF + GA	6.0 + 10 ppm	8.3	6.8	7.7	7.6
Vitavax Maneb FF + GA + IAA	6.0 + 10 ppm + 5 ppm	8.9	7.8	7.3	8.0
Captan 400 D	3.0	8.7	6.3	6.8	7.3
Captan 400 D + GA	3.0 + 10 ppm	8.3	7.7	6.5	7.5
Captan 400 D + GA	3.0 + 20 ppm	9.2	8.0	8.5	8.6*
Captan 400 D + GA + IAA	3.0 + 10 ppm + 5 ppm	8.6	7.5	8.1	8.1
Apron F1	0.75	8.8	7.9	6.2	7.6
Apron F1 + GA	0.75 + 10 ppm	10.1	8.4	8.4	9.0**
Apron F1 + GA	0.75 + 20 ppm	10.0	7.7	8.3	8.7*
Apron F1 + GA + IAA	0.75 + 10 ppm + 5 ppm	9.5	7.5	7.9	8.3
C2338 50wp	2.0	8.8	6.3	7.1	7.4
C2338 50wp	4.0	8.4	6.5	6.8	7.2
C2338 50wp + GA	4.0 + 10 ppm	8.1	6.0	6.9	7.0
C2338 50wp + GA + IAA	4.0 + 10 ppm + 5 ppm	9.3	7.6	7.0	8.0
GA	10 ppm	8.3	8.4	7.2	8.0
GA	20 ppm	9.0	7.0	8.0	8.0
GA + IAA	10 ppm + 5 ppm	7.8	7.2	7.8	8.0
GA + IAA	20 ppm + 5 ppm	8.5	8.3	7.8	8.2
Dithane F-45	3.2	7.3	8.4	7.1	7.6
Dithane F-45	6.0	8.7	8.1	7.4	8.1
Dithane F-45 + GA	3.2 + 10 ppm	7.7	7.3	6.2	7.1
Dithane F-45 + GA + IAA	3.2 + 10 ppm + 5 ppm	8.2	6.8	8.4	7.8
Dithane F-45 + GA	6.0 + 10 ppm	8.0	7.3	7.1	7.5
Dithane F-45 + GA + IAA	6.0 + 10 ppm + 5 ppm	7.7	6.8	6.9	7.1
Nusan 30 Ec	1.0	7.2	8.2	6.9	7.4
Nusan 30 Ec	1.25	8.1	6.6	7.1	7.3
Nusan 30 Ec + GA + IAA	1.25 + 10 ppm + 5 ppm	7.4	8.0	7.9	7.8
LSD .01					1.3
LSD .05					0.1

CHEMICAL CONTROL OF BLAST IN LOUISIANA

G.D. Lindberg and M.C. Rush

INTRODUCTION

Chemical control of rice blast is one part of a broader program of chemical control of foliar diseases of rice. Coordination of all chemical control studies in rice provides us with a better knowledge of the full capabilities of all of the materials that are used.

MATERIALS AND METHODS

The blast susceptible California rice variety M-201 was planted April 29, 1987. A randomized complete block design with five replicates was used for this test. The plots measured 4 ft x 20 ft with seven drill rows on a 7 inch spacing. All of the fertilizer was applied at the rate of 120-60-60 lb of total N, P, and K per acre. The chemicals were applied with a 2 nozzle (8002) boom at the rate of 20 gal/A and approximately 40 psi. Fourteen fungicide rates were used with an application at the booting stage (July 7) and one at the heading stage (July 17) (Table 1). Five samples of 20 panicles in each plot were counted and the percent rotten-neck determined based on the mean percentage of panicles infected. The center four rows were harvested (46.7 sq. ft.) with a small-plot combine.

RESULTS AND DISCUSSION

Severe blast development occurred in the M-201 rice in 1987. All of the chemical treatments resulted in significantly fewer rotten-neck panicles than the untreated plots (Table 1). Some materials, however, were far superior to others in the control of rotten-neck. The Benlate 50 wp treatment at 2 lb/A applied at boot and heading decreased rotten-neck blast by 38%. The 2 pint/A rate of Kasugamycin 2% EC increased yield 102% over the unsprayed control. The 2 lb/A rate of Benlate 50 wp increased yield 84% over the control plots. Most of the treatments that gave significant decreases in rotten-neck blast also significantly increased yield. In addition to rotten-neck blast, most panicles also had lesions on the panicle branches. These infections were greatly reduced in the RH-3486 50 wp + CS-7, Kasugamycin 2% EC, and Benlate 50 wp treatments.

The cultivar M-201 is a California cultivar that is susceptible to most of the races of Pyricularia oryzae Cav. that occur in the United States. It is poorly suited for growing in the South and would be expected to have lower yields (4500 lb/A) than the better adapted cultivars.

Table 1. The effects of foliar fungicides on rotten-neck blast and yield.
Rice Research Station, Crowley, LA. 1987.

Treatments	Rate (formulated/A)	Timing	% Rotten neck blast ^{a/}	Yield (lb/A)
Unsprayed control	-	-	98.6	2030
Fungorene 50 wp	0.5 lb	B,H	93.2	2408
Fungorene 50 wp	1.0 lb	B,H	92.0	2869
Fungorene 50 wp	1.5 lb	B,H	93.2	2728
RH-3486 50 wp + CS-7	2.0 lb + 0.17 pt	B,H	60.2**	2830
Kasugamycin 2% EC	1.0 pt	B,H	83.8**	3022**
Kasugamycin 2% EC	1.5 pt	B,H	76.6**	3582**
Kasugamycin 2% EC	2.0 pt	B,H	70.0**	4107**
Benlate 50 wp	1.0 lb	B,H	81.0**	3233**
Benlate 50 wp	2.0 lb	B,H	60.6**	3741**
C2328 10% EC	2.5 pt	B,H	89.0	2395
Folicur 1.2 E	1.2 pt	B,H	93.0	2402
Folicur 1.2 E	1.5 pt	B,H	84.2**	2844
PP523 0.5 Sc	6.4 pt	B,H	96.2	2313
Dithane F45	9.5 pt	B,H	79.0**	2788
LSD 0.01			13.8	854

^{a/} Means marked with a double asterisk were significantly different from the untreated control at the P = 0.01 level.

SOMACLONAL VARIATION FOR RICE IMPROVEMENT

Xie, Q. J., M. C. Rush and J. Cao

INTRODUCTION

Somaculture systems have been developed for rice, wheat, sugarcane, and many other cereal and dicot plants. Recent research has demonstrated that extensive changes in the initial germplasm of rice and cereal crops can be generated by subjecting a cultivar or breeding line to somatic cell culture. These changes, called somaclonal variation, include differences in the somaculture progeny in disease resistance, physiology, plant height, plant type, tillering, panicle characteristics, grain type and quality, grain weight, and kernel numbers. The developing tissue culture techniques are supplying plant breeders with a novel approach for the improvement of crops.

In 1984, we established a somaculture system that enables us to regenerate plants from immature rice panicles at a very high frequency. Up to now, more than 10,000 plants from 11 varieties have been regenerated by using this system. The purpose of this research is to screen from the thousands of somaclonal lines the useful variants that may serve as new germplasm sources.

MATERIALS AND METHODS

Three experiments were conducted during 1986 and 1987:

1) Observation of morphological variation: In 1986, two thousand T2 generation lines and nine hundred T3 generation lines from the 10 varieties Labelle, Lemont, Melrose, Tetep, Tadukan, Taipei 309, Zenith, Saturn, Giza 159, and Leah were planted in the field at the Louisiana Rice Research Station. There was a parent cultivar as a check after each 10 line rows. Each line was planted as a single 5-foot row with 10 inches between rows. Observations were made on morphological variation, such as plant height, plant type, grain type, heading date, fertility, color panicle size, pubescence, and panicle exertion. Thirty T2 lines with non-segregating variation were selected for genetic studies. In 1987, each selected line was planted in 30 panicle rows. Fifteen lines with easily distinguished, non-segregating variation were selected for making reciprocal crosses with their parent varieties. A few F₁'s were also planted in the field in 1987. Five hundred T2 somaclonal lines from EMS treatments were planted in single 4-foot rows with 10-inch spacing between rows for each line.

2) Evaluation of disease resistance: Research on evaluation of disease resistance was concentrated on rice sheath blight and blast. In 1986, 1,400 T2 lines were inoculated at the boot stage with Rhizoctonia solani at 10 ml inoculum for each 2.5 foot row (the other half of each 5-foot row was not inoculated) (1,2). In 1987, fifty somaclonal lines screened in the field for variation in resistance to rice blast were sent to Dr. Toni Machetti; USDA, ARS-Beaumont, TX for further testing for their blast reaction under controlled conditions. Five somaclones, 85-163, 85-682, 85-799-1, 86-20001, and 86-21722, were screened in the field and greenhouse for resistance to rice sheath blight

along with the parent cultivars Labelle and Zenith, as well as the highly resistant cultivars Tetep and Tadukan. In the field, forty panicle lines of 86-2001, four lines of the parent cultivar Labelle, and six panicle lines of the susceptible line 86-20002, grown in 5-foot rows, were inoculated twice (45 days and boot stage) with R. solani at 25 ml inoculum for each 5-foot row.

3) Testing of yielding ability: A yield comparison test was conducted in 1986 with three somaclones, 85-215-, 85-85-726, 85-806, and the cultivars Labelle and Lemont. The cultivars and lines were planted in 50 square foot plots with six rows in each plot; a row spacing of 10 inches and a row length of 10 feet. Fertilizer was applied at a rate of 600 lb/A 20-10-10 (N-P₂O₅-K₂O) before flooding. A randomized complete block design with five replications was used. Plots were hand-harvested, and yields were adjusted to 12% moisture. Another yield comparison was conducted in 1987. Five somaclonal lines, 85-215, 86-20712, 86-20756-1, 86-20756, 86-30426, and the three parent cultivars, Labelle, Lemont, and Leah, were planted in the manner outlined above except that there were three replications and the plots were harvested with a small-plot combine.

RESULTS AND DISCUSSION

Variation in Morphological Characteristics:

Several kinds of morphological variation were observed among the 2000 T2 lines and 900 T3 lines in the field in 1986. The type of variation and their frequencies are shown in Table 1.

A phenomenon that appears with somaclonal variation is that many variants do not show segregation in the second generation (T2). This phenomenon cannot be explained by classical genetic theory, and it will be difficult for breeders to use the variants efficiently until the genetic mode of the somaclonal variation is established. We are conducting research to solve this problem.

Variation in disease resistance:

The variation observed in disease resistance to rice blast and sheath blight are shown in Table 2.

Ninety-three lines showed variation for blast resistance. Some of the lines were more susceptible than the parent cultivars and some lines were significantly more resistant. According to the evaluation conducted by Dr. Marchetti, four lines, 85-163, 85-682, 86-20001, and 86-21722, showed much higher blast resistance than their parent cultivars.

Thirty-eight lines showed variation in rice sheath blight resistance. Disease ratings obtained in the greenhouse test conducted by Mr. R. Massaquoi are shown in Table 3. Using the 0-9 disease rating system (1,2), the resistance of all five somaclonal lines was better than that of their parent cultivars and the performance of four Labelle lines similar to that of the resistant cultivars Tetep and Tadukan. The agronomic characteristics of Tetep and Tadukan are very poor. This makes these cultivars difficult to use as sources of sheath blight resistance. According to recent research in China, the resistance of Tetep to sheath blight is controlled by a polygene system

Table 1. Morphological variation among somaclonal lines planted in 1986. Rice Research Station, Crowley, LA.

Main Variant Characteristic	Number of lines showing variation			
	T2 generation		T3 generation	
	Segregating	Not segregating	Total	Total
Plant height	34	249	283	76
Plant type	1	9	10	51
Grain type	4	33	37	58
Heading data	17	90	117	52
Fertility	9	12	21	19
Color	18	21	39	3
Larger panicles	-	-	17	1
Dense panicle branching	-	-	1	2
Pubescent	4	-	4	11
Improved exsertion	-	-	5	5

Table 2. Apparent variation for increased or decreased disease resistance in somaclones planted in 1986. Rice Research Station, Crowley, LA.

Characteristics	Number of lines showing variation	
	T2 generation	T3 generation
Sheath blight resistance	35	3
Blast resistance	81	12

Table 3. Disease Rating of Sheath Blight Resistant Somaclones. Rice Research Station, Crowley, LA. 1987.

Parent cultivar	Somaclone or cultivar	Disease rating (0-9 scale)
Labelle		9
Labelle	85-163	1
Labelle	85-682	1-3
Labelle	85-799-1	1-3
Labelle	86-20001	1-3
Zenith	Cultivar	7
Zenith	86-21722	5
Tetep	Cultivar	3
Tadukan	Cultivar	3

which makes it more difficult for the breeder to use Tetep in the program. The agronomic characteristics of two somaclones, Labelle 85-163 and Labelle 86-20001, were much better than those of Tetep and Tadukan, especially in plant type and grain quality.

In 1987, we continued to test the sheath blight resistance of Labelle 86-20001 as this line combined high sheath blight resistance with acceptable agronomic characteristics. The plants were first inoculated with R. solani 45 days after planting. Ten days after inoculation clear symptoms of sheath blight appeared on the parent Labelle, but no lesions showed on 86-20001. After 20 days the lesions on Labelle spread quickly with 51% of the tillers showing infection. The infected tillers had an average lesion length of 9.3 cm. Some lesions developed on 86-20001, but only 17% of the tillers were affected by R. solani, and the average lesion length was only 3.5 cm. The plants were inoculated again at the late booting stage. The results are shown in Table 4. We inoculated 40 panicle lines of 86-20001 with 25 ml inoculum per line each time. The results shown in Table 4 confirmed that the resistance level of 86-20001 is very high. This somaclone may be registered as elite germplasm.

Variation of selected somaclones in yielding ability:

The results of 2 year's yield comparison tests are shown in Tables 5 and 6.

Among the three somaclones tested in 1986, the yield of 85-215 was slightly higher than that of the Lemont cultivar, but not significantly higher.

Among the five somaclonal lines tested in 1987, the yields of all the lines were higher than those of their parent cultivars. However, none of them were significantly higher than those of the cultivars except 86-30426. The somaclone 86-30426 showed excellent yielding potential. Its yield was almost twice as much as those of the other lines and cultivars. Most of the agronomic characteristics of this line were excellent. But, more research still has to be conducted on evaluating the disease resistance and grain quality of this line.

Table 4. Comparison of sheath blight development in the field on inoculated rows of the somaclones 86-20001 and 86-20002 and the parent cultivar Labelle. Rice Research Station, Crowley, LA. 1987.

Line or Cultivar	Tillers diseased		Disease rating	
	%	Sd ^{1/}	Mean rating	Sd ^{1/}
86-20001	12.6	1.9	1.5	0.18
86-20002	100.0	0.0	9.0	0.00
Labelle	98.0	2.0	7.0	0.71

^{1/} Standard deviation.

Table 5. Comparison of yield of selected somaclones with the cultivars Labelle and Lemont in 1986. Rice Research Station, Crowley, LA.

Line	Yield (lb/A)	
85-215	5199.2	A
Lemont	4831.8	AB
Labelle	4730.6	B
85-726	4549.2	B
85-806	3740.2	C
LSD (0.05)	459.0	

Table 6. Comparison of yield of five somaclones with the cultivars Leah, Labelle, and Lemont in the field in 1987. Rice Research Station, Crowley, LA.

Cultivar or Line	Yield (lb/A)	
86-30426 (Breed. line)	9571	A
85-215 (LEAH)	5895	B
Leah	5349	BC
86-20756-1 (LMNT)	5166	BC
86-20756 (LMNT)	4997	BC
86-20712 (LABL)	4910	BC
Labelle	4504	C
Lemont	4233	C
LSD(0.05)	1287	

FEEDER ROOT NECROSIS IN RICE

R.W. Schneider and M.C. Rush

INTRODUCTION

Feeder root necrosis (FRN), a recently coined descriptive term, has been reported on several crop plants. It is thought to be involved in the apple replant disorder, wheat and alfalfa yield decline, and most recently, stubble decline in sugarcane. FRN is difficult to diagnose in that plants do not wilt or collapse, and there is no obvious rotting of primary roots. All plants in a field or region may be affected so that there are no healthy plants with which to make a comparison. For these reasons FRN has been referred to as a cryptic disease.

The disease is characterized by a necrosis or discoloration of the fine feeder root system. In extreme cases the infection may spread to the primary roots causing lesions to form where feeder roots were attached. Several pathogenic fungi have been implicated in this disorder, but species of Pythium are almost always involved. This fungus is widely distributed and has a broad host range.

In the past yield losses caused by FRN have been difficult to document in the field because soil-applied fungicides with specific activity against Pythium spp. had not been available, and other pathogenic fungi may have been involved. Nevertheless, numerous studies were published describing the "fumigation response" in which growth and yield of several crops were enhanced following treatment of the soil with broad spectrum fumigants such as methyl bromide/chloropicrin and metam sodium. Results from these fumigation studies suggested that biotic agents were involved in the growth response, but evidence implicating a specific pathogen or groups of pathogens was lacking. However, in recent years a fungicide, metalaxyl, with specific activity against Pythium spp., was made available that now allows us to assess the role of this fungus as a cryptic pathogen.

The original intent of the present research program was to determine if FRN occurs in rice. By using metalaxyl as an experimental tool, we not only demonstrated the occurrence of FRN but also found that it is quite severe and could be controlled with metalaxyl and metam sodium. These two chemicals are the generic names for Ridomil (CIBA-GEIGY Corp.) and Busan 1020 (Buckman Laboratories, Inc.), respectively.

PROCEDURES

Field experiments were conducted at the Rice Research Station in Crowley, Louisiana during 1985-1987. The procedures and results for 1987 only are presented. Plots were individually leveed so that chemical treatments and irrigation water could be precisely controlled. The variety Lemont was water-seeded at 125 lb/A on May 13, 1987. Fertilizer, 600 lb/A of 20-10-10, was broadcast when the permanent flood was applied, and ammonium sulfate at 90

lb/A was applied at 35 days after planting (DAP). Weeds were controlled with an application of Propanil at 13 DAP, and Furadan was applied at 35 DAP to control the rice water weevil.

Having already established that Pythium spp. are responsible for FRN in rice, the chemical treatments were confined to metalaxyl and metam sodium. The objectives of the experiment were to evaluate rates and methods of application, to compare the liquid (Ridomil 2E) and granular (Ridomil 5G) formulations of metalaxyl, and to evaluate water management practices with metam sodium. Metalaxyl, at appropriate concentrations, can be applied directly to plants or soils in which plants are growing, while metam sodium, a broad spectrum biocidal fumigant, must be applied before planting so that it can decompose or dissipate. There were 20 treatments (Table 1) each with four replications.

RESULTS AND DISCUSSION

Metalaxyl, applied in the flood at 9 days before planting at 1, 2, 4 and 8 pt/A (Treatments 2, 3, 4, and 5, respectively), significantly increased stand (87%), shoot length (26%), and shoot weight (50%) over the control (Treatment 1). There was a definite rate effect with the 1 to 2 pint rates being more effective than higher rates, suggesting that metalaxyl is relatively phytotoxic to rice as compared to other crop plants, and precise rates of application must be determined in order to derive the maximum benefit. This was confirmed in greenhouse studies. In other treatments the chemical was sprayed on the soil surface immediately before flooding and planting to simulate an aerial application (Treatments 6 and 7). This was by far the best method of application and gave the best growth and yield responses. These results are particularly encouraging in that a preplant flood will not have to be maintained, and there should be no alteration in current cultural practices. In addition, the optimum rate of application was 1 pt/A suggesting that there was a significant loss of fungicidal activity during the 9 days between application and planting in the former procedure. Inasmuch as metalaxyl is specific in its activity against Pythium spp., these results confirm our previous findings that this fungus is the primary FRN etiological agent and should be considered as a major constraint to rice production.

Metam sodium, applied in the flood water 9 days before planting at 10, 20, and 30 gal/A (Treatments 11-15), resulted in significant increases in shoot length (26%) and shoot weight (108%) over the control. The optimum application rates were 10 and 20 gal/A. Besides affecting plant growth parameters and yield components, metam sodium also provided a substantial measure of weed control.

There were significant increases in yield in several treatments. Metalaxyl at 2 pt/A (Treatment 3), applied 9 days before planting in the flood water, and at 1 pt/A, sprayed on the soil surface immediately before planting (Treatment 6), resulted in yields that were 19% and 28% above the appropriate controls, respectively. Similar results were obtained following applications with the granular formulation at 4 oz/A (Treatment 8). Metam sodium at 10 gal/A (Treatment 12) resulted in yield that was 28% greater than the control (Treatment 11). The largest absolute yields were 5592 and 5547 lb/A in the metalaxyl (Treatment 6) and metam sodium (Treatment 15) treatments,

Table 1. - Treatments evaluated for the control of feeder root necrosis in rice. Rice Research Station, Crowley, LA. 1987

Treatment no.	Chemical ^{1/}	Rate of application (units/A)	Method of application ^{2/}	Water management ^{3/}
1	Control	-	-	a
2	Metalaxyl (ec)	1 pint	1	a
3	Metalaxyl (ec)	2 pints	1	a
4	Metalaxyl (ec)	4 pints	1	a
5	Metalaxyl (ec)	8 pints	1	a
6	Metalaxyl (ec)	1 pint	2	b
7	Metalaxyl (ec)	2 pints	2	b
8	Metalaxyl (g)	4 ounces	3	b
9	Metalaxyl (g)	8 ounces	3	b
10	Metalaxyl (ec)	2 pints	1	c
11	Control	-	-	d
12	metam sodium	10 gal	1	d
13	metam sodium	20 gal	1	d
14	metam sodium	30 gal	1	d
15	metam sodium	20 gal	1	e
16	metalaxyl (ec)	4 pints	4	a
17	metalaxyl (ec)	4 pints	5	a
18	metalaxyl (ec)	1 pint	6	b
19	metalaxyl (ec)	2 pints	6	b
20	Control	-	-	b

^{1/} ec - emulsifiable concentrate; g - granules

^{2/} 1 = applied 9 days before planting in the flood water; 2 = sprayed on dry soil surface immediately before flooding and planting; 3 = granules dispersed on soil surface immediately before flooding and planting; 4 = as in no. 1 with second application of metalaxyl (0.5 pt/A) at 42 days after planting; 5 = as in no. 1 with second application of metalaxyl (1 pt/A) at 42 days after planting; and 6 = applied in flood water immediately before planting.

^{3/} a = maintained continuous flood for 9 days before planting, then drained one week after planting; b = flooded at planting, flushed and drained 8 days later; c = as in 'a' plus a flush at 8 days after planting; d = maintained continuous flood for 9 days, then planted and drained. Flushed and drained 6 days later; and e = as in 'd' but maintained continuous flood after planting.

All plots were flushed at 9 days after planting, Propanil was applied 4 days later, and the permanent flood was imposed 2 days after that.

Table 2. Effects of metalaxyl and metam sodium on rice growth and yield.
Rice Research Station, 1987.

Treatment ^{a/}	Stand (plants/ft ²)		Shoot weight (g/5 plants) ^{b/}		Panicles per ft ²	Yield (lbs/A)
1	14.5	-	8.5	-	31.4	4438 -
2	22.3	(54) ^{c/}	8.8	(4)	33.6	4958 (12)
3	26.3	(81)	8.9	(5)	33.3	5288 (19)
4	25.4	(75)	13.4	(58)	32.2	4922 (11)
5	27.1	(87)	9.0	(6)	34.3	4841 (9)
6	26.5	(27)	12.8	(47)	35.7	5592 (28)
7	20.1	(-3)	12.1	(39)	32.9	5141 (17)
8	-	-	-	-	33.1	4970 (14)
9	26.6	(28)	11.3	(30)	34.9	5213 (19)
10	-	-	-	-	33.4	5174 (17)
11	12.1	-	12.1	-	28.2	4171 -
12	20.8	(72)	14.9	(23)	35.6	5355 (28)
13	19.2	(59)	17.5	(45)	35.9	5114 (23)
14	29.0	(140)	13.2	(9)	32.6	4916 (18)
15	-	-	-	-	37.4	5547 (25)
16	-	-	-	-	35.3	5517 (15)
17	-	-	-	-	34.9	4736 (7)
18	24.0	(15)	10.3	(18)	33.9	4988 (14)
19	19.7	(-5)	8.5	(-2)	34.9	4829 (10)
20	20.8	-	8.7	-	34.8	4378 -
LSD (P = 0.05)	4.2		2.8		4.5	458

^{a/} Refer to Table 1 for descriptions of the chemical treatments and water management practices.

^{b/} At 47 days after planting.

^{c/} Figures in parentheses indicate percent increase over appropriate control.

respectively. Controls yielded 4438, 4171 and 4378 lb/A for the three water management systems (Treatments 1, 11 and 20).

Plant development, yield component and root infection data, collected several times during the season, were useful in evaluating the treatment effects. A quantitative root infection assay, developed in this research project, clearly showed that infection need only be controlled for the first 3 weeks after planting. Higher rates of metalaxyl, which delayed root infection by up to 7 weeks, or supplemental applications of metalaxyl (Treatments 16 and 17) did not further increase plant growth parameters or yield. The better treatments resulted in more tillers, immature panicles and biomass per unit area at 21, 47 and 82 DAP, but the percentage of panicles that developed to maturity at 119 DAP was lowest in the higher yielding treatments (Tables 3, 4, 5 and 6). These results suggest that panicle initiation was greatly enhanced by controlling FRN but that nutrient levels, especially nitrogen, must be increased in order to promote grain filling. We must now concentrate on the nutritional status of rice plants in which FRN has been controlled inasmuch as previous recommendations were developed for FRN-affected plants.

An added benefit of the better treatments was the control of seedling water-mold disease, caused by Pythiaceus fungi, as evidenced by more than 90% seedling emergence. Experiments will be conducted in 1988 at the Rice Research Station to determine if the water-mold disease can be controlled in very early plantings. In addition, there was a significant effect on tillering in the ratoon crop (Table 7).

CONCLUSIONS

Our findings from the past 3 years clearly show that rice is affected by FRN and that this disorder is probably a major yield constraint. Fortunately, the chemicals used to demonstrate the occurrence of this disorder also appear to be promising disease control agents for not only FRN but also the seedling disease caused by Pythium species. In addition, metam sodium provided a substantial level of weed control and has been reported to control pathogens in the soil such as Rhizoctonia solani, causal agent of sheath blight on rice.

Several studies must be completed before firm recommendations can be made. All Louisiana rice growing areas will be surveyed for the presence of FRN. It is likely that the disease will be widely distributed inasmuch as the Pythium spp. involved have broad host ranges. Optimum rates of application of metalaxyl and metam sodium must be confirmed. An optimum seeding rate must be established, probably considerably lower than current recommendations, in that near perfect stands have been obtained routinely in the experimental treatments. Fertilization and other agronomic practices may have to be modified as a result of controlling FRN because of the increased growth and tillering. Rice cultivars should be evaluated for their tolerance to FRN. It should be noted that metalaxyl, when applied as a soil fungicide, is not registered for use on rice at this time.

Table 3. Effect of metam sodium on tiller density and biomass at 21, 47 and 82 days after planting (DAP). Rice Research Station, Crowley, LA. 1987.

Trt. no.	Tillers/ft ² at DAP			Biomass (g/ft ²) at DAP ^{a/}		
	21	47	82	21	47	82
Control (1)	12.1	62.9	73.8	0.73	29.3	140.6
12	25.0	112.3	95.7	1.87	62.0	201.3
13	36.5	97.9	96.0	2.40	67.2	200.4
14	52.2	133.4	133.4	3.0	76.6	268.5

^{a/} Dry weight.

Table 4. Effect of metalaxyl treatments on tiller density and biomass at 21, 47 and 82 days after planting (DAP). Rice Research Station, Crowley, LA. 1987.

Trt. No.	Tillers/ft ² at DAP			Biomass (g/ft ²) at DAP		
	21	47	82	21	47	82
Control (11)	24.6	62.3	69.6	0.92	24.6	146.7
2	26.8	89.2	89.2	1.90	39.2	154.3
3	36.8	84.2	110.4	2.19	46.8	203.6
4	40.6	86.7	121.9	2.41	68.1	201.2
5	35.2	83.8	101.6	2.44	49.3	158.3
6	50.3	132.5	132.5	2.83	67.8	231.6
7	36.2	84.4	92.5	2.21	48.6	154.4
Control (20)	29.1	66.6	81.1	1.56	36.2	124.9

Table 5. Effect of metam sodium treatments on plant stand, panicle initiation (bootstage) and filled panicles. Rice Research Station, Crowley, LA. 1987.

Treatment number	Plant stand (plants/ft ²)	82 DAP (bootstage)		119 DAP	
		Immature panicles per plant ^{a/}	Panicles per ft ^{2a/}	Harvested panicles per ft ^{2b/}	Percent of panicles with mature seed
Control (11)	12.1	2.1	25.4	28.2	111.0
12	20.8	2.3	47.8	35.6	74.5
13	19.2	3.0	57.6	35.9	62.3
14	29.0	2.8	81.2	32.6	40.2

^{a/} Panicles in the boot.

^{b/} Emerged panicles that filled by 119 DAP.

Table 6. Effect of metalaxyl treatments on plant stand, panicle initiation (bootstage) and filled panicles. Rice Research Station, Crowley, LA. 1987.

Treatment number	Plant stand (plants/ft ²)	82 DAP (bootstage)		119 DAP	
		Immature panicles per plant ^{a/}	Immature panicles per ft ^{2a/}	Harvested panicles per ft ^{2b/}	Percent of panicles with mature seed
Control (1)	14.5	2.2	31.9	31.4	98.4
2	22.3	2.4	53.5	33.6	62.4
3	26.3	2.6	68.3	33.3	48.8
4	25.4	2.0	54.2	34.3	63.3
5	27.1	2.0	50.8	32.2	63.4
16	-	2.5	-	35.3	-
17	-	2.2	-	34.9	-
6	26.5	2.8	74.2	35.7	48.1
7	20.1	2.6	52.3	32.9	62.9
Control (20)	20.8	2.2	38.8	34.8	89.7

^{a/} Panicles in the boot.

^{b/} Emerged panicles that filled by 119 DAP.

Table 7. Effects of metalaxyl and metam sodium on ratoon regrowth. Rice Research Station, Crowley, LA. 1987.

Treatment No.	Tillers per ft. ^{2a/}
6	43.2
7	38.8
Control (20)	27.7
12	38.1
13	40.8
14	43.3
Control (11)	24.6

^{a/} Plots were reflooded after harvest and counts were made 22 days later.

WEED CONTROL RESEARCH

INTRODUCTION

Southwest Louisiana has an abundance of weed species, some not commonly found in other areas of the state. Our climatic conditions are favorable to prolific weed growth and subsequent competition with crop species. For both soybeans and grain sorghum, the majority of the acreage is drill- or broadcast-planted. Consequently, producers are limited to using preemergence or postemergence over-the-top herbicide treatments. The more economical weed control options such as cultivation or band application of herbicides, which could be used in a wide row system, are not available in a solid-seeded system.

This progress report summarizes weed control studies conducted in soybeans during the 1987 growing season. Results of herbicide efficacy and crop tolerance studies are presented. Much of the research data is preliminary since evaluation of many of the herbicides is limited. Data presented in this report should not be considered as an endorsement or recommendation of any herbicide. Registration by the Environmental Protection Agency is required before any herbicide can be legally used.

Herbicides and adjuvants evaluated in 1987 are shown in Table 1. Selected weed areas on the Rice Research Station and at several off-station sites have been managed to encourage uniform weed populations. Weed species evaluated for control are presented in Table 2. Specific information on location, soil type, variety, row spacing, treatment date, sprayer type, etc., for all experiments are individually presented followed by a table of results. Miscellaneous abbreviations used in describing each experiment are shown in Table 3. Weed control and crop injury ratings for all experiments are based on a scale of 0-100%, where 0 equals no control or crop injury and 100 equals complete control or crop injury. Where appropriate, crop yields were obtained and adjusted to 13% moisture.

Table 1. Herbicides and adjuvants evaluated in soybeans and rice at the Rice Research Station, Crowley, LA, and at several off-station sites. 1987.

Trade name	Common name	Chemical name	Manufacturer
Ag 98	nonionic surfactant		Rohm & Haas
Agridex	Crop oil concentrate		Helena
AC 263,222	---	---	American Cyanamid
Assure	quizalofop	(+)-2-[4[(6-chloro-2-quinoxalinyloxy)phenoxy]propanoic acid	Dupont
Basagran	bentazon	3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide	BASF
BAS 090	---	---	BASF
BAS 514	quinclorac	3,7-dichloro-8-quinoline-carboxylic acid	BASF
BAS 517	cycloxydim	2-[1-(ethoxyimino)-butyl]-3-hydroxy-5-(2H-tetrahydrothiopyran-3-yl)2-cyclohexene-1-one	BASF
Blazer	acifluorfen	5-[-2-chloro-4-(trifluoromethyl)-phenoxy]-2-nitrobenzoic acid	BASF
Bolero	thiobencarb	S-[(4-chlorophenyl)methyl]diethylcarbamoate	Chevron
Buctril	bromoxynil	3,5-dibromo-4-hydroxybenzonitrile	Rhone Poulenc
Butyrac	2,4-DB	4-(2,4-dichlorophenoxy)butyric acid	Union Carbide
Canopy	metribuzin + chlorimuron	---	Dupont

Continued.

Table 1. Continued.

Trade name	Common name	Chemical name	Manufacturer
Cinch	cinmethylin	exo-1-methyl-4-(1-methylethyl)-2-[2-methylphenyl]-methoxy]-7-oxabicyclo[2.2.1]heptane	Shell
Classic	chlorimuron	2-[[[(4-chloro-6-methoxy-2-pyrimidinyl) amino]carbonyl] amino]sulfonyl]benzoic acid	Dupont
Crossbow	triclopyr + 2,4-D	---	Dow
Cobra	lactofen	(+)-2-ethoxy-1-methyl-2-oxoethyl-5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate	PPG
Command	clomazone	2-(2-chlorophenyl)methyl-4,4-dimethyl-3-isoxazolidinone	FMC
	2,4-D	(2,4-dichlorophenoxy)acetic acid	Several
Dash (BAS 815)	---	---	BASF
Dual	metolachlor	2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide	Ciba Geigy
Fusilade	fluazifop	(+)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid	ICI
Fusilade 2000	fluazifop	(R)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid	ICI
Garlon	triclopyr	[(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid	Dow
Gemini	linuron + chlorimuron	---	Dupont

Continued.

Table 1. Continued.

Trade name	Common name	Chemical name	Manufacturer
Hoelon	diclofop	(+)-2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid	Hoechst-Roussel Agri-Vet
Lasso MT	alachlor	2-chloro-N-(2,6-diethyl)-N-(methoxymethyl) acetamide	Monsanto
Lexone	metribuzin	4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one	Dupont
Londax	bensulfuron-methyl	---	Dupont
Lorox	linuron	N'-(3,4-dichlorophenyl)-N-methoxy-N-methylurea	Dupont
M60	bentazon + MCPA	---	Monsanto
MON 7242	--	--	Monsanto
Ordram	molinate	S-ethyl hexahydro-1H-azepine-1-carbothioate	Stauffer
Partner	alachlor + imazaquin	---	Monsanto
Poast	sethoxydim	2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one	BASF
Prowl	pendimethalin	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine	American Cyanamid
Pursuit	imazaethapyr	(+)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid	American Cyanamid
Reflex	fomesafen	5-[2-chloro-4-(trifluoromethyl)phenoxy]-N-(methylsulfonyl)-2-nitrobenzamide	ICI

Continued.

Table 1. Continued.

Trade name	Common name	Chemical name	Manufacturer
Salute	trifluralin + metribuzin	---	Mobay
Sencor	metribuzin	4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one	Mobay
Select	cloproxydim	(E,E)-2-[1-[[3-chloro-2-propenyl)oxy]imino]butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one	Chevron
Scepter	imazaquin	(+)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridine-carboxylic acid	American Cyanamid
Squadron	pendimethalin + imazaquin	---	American Cyanamid
Stam	propanil	3',4'-dichloropropionanilide	Rohm & Haas
Storm	bentazon + acifluorfen	---	BASF
Tackle	acifluorfen	5-[2-chloro-4-(trifluoromethyl)-phenoxy]-2-nitrobenzoic acid	Rhone Poulenc
Treflan	trifluralin	2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine	Elanco
Turbo	metolachlor + metribuzin	---	Mobay
Verdict	haloxyfop	2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid	Dow
Whip	fenoxaprop	(+)-2-[4-[6-chloro-2-benzoxazolyl]oxy]-phenoxy]propanoic acid	Hoechst-Roussel Agri-Vet

Table 2. Abbreviations of weed species evaluated in weed control studies conducted at the Rice Research Station, Crowley, LA, and at several off-station sites. 1987.

Abbreviation	Common name	WSSA abbreviation	Scientific name
AS	annual sedge	---	<u>Cyperus</u> sp.
AW	alligatorweed	ALRPH	<u>Alternanthera philoxeroides</u> (Mart.) Griseb.
BG	bermudagrass	CYNDA	<u>Cynodon dactylon</u> (L.) Pers.
BSG	broadleaf signalgrass	BRAPP	<u>Brachiaria platyphylla</u> (Griseb.) Nash
BYG	barnyardgrass	ECHCG	<u>Echinochloa crus-galli</u> (L.) Beauv.
CB	cocklebur	XANST	<u>Xanthium strumarium</u> L.
DF	dayflower	COMDI	<u>Commelina diffusa</u> Burm. f.
DS	duck salad	HETLI	<u>Heteranthera limosa</u> (Sw.) Willd.
EC	eclipta	ECLAL	<u>Eclipta prostrata</u> L.
HS	hemp sesbanica	SEBEX	<u>Sesbania exaltata</u> (Raf.) Rydb. ex A.W. Hill
IG	itchgrass	ROOEX	<u>Rottboellia exaltata</u> L.f.
JR	junglerice	ECHCO	<u>Echinochloa colonum</u> (L.) Link
JV	indian jointvetch	AESIN	<u>Aeschynomene indica</u> L.
MW	mexicanweed	CNPCA	<u>Caperonia castaniifolia</u> (L.) St. Hil.
PLMG	palmleaf morningglory	IPOWR	<u>Ipomoea wrightii</u> Gray
PMG	pitted morningglory	IPOLA	<u>Ipomoea lacunosa</u> L.
PNS	purple nutsedge	CYPRO	<u>Cyperus rotundus</u> L.
RR	red rice	ORYSA	<u>Oryza sativa</u> L.
RW	redweed	MEOCO	<u>Melochia corchorifolia</u> L.
SP	sicklepod	CASOB	<u>Cassia obtusifolia</u> L.
WP	wild poinsettia	EPHHL	<u>Euphorbia heterophylla</u> L.

Table 3. Miscellaneous abbreviations used in weed control studies conducted at the Rice Research Station, Crowley, LA, and at several off-station sites. 1987.

CV	Coefficient of variation
DF	Dry flowable
DP	Delayed preemergence
EC	Emulsifiable concentrate
EP	Early postemergence
GPA	Gallons per acre
lb ai/A	Pounds active ingredient per acre on a broadcast basis
L	Liquid
LP	Late postemergence
LSD	Least significant difference
PES	Preemergence surface applied
PoF	Post flood
PoFL	Post flood late
PPI	Preplant soil incorporated
PrF	Pre flood
psi	Pounds per square inch pressure
RCB	Randomized complete block experimental design
VEP	Very early postemergence
WP	Wettable powder
WDG	Water dispersible granule
/	Indicates sequential application
(+)	Indicates a tank mix

SOYBEAN WEED CONTROL RESEARCH

J.L. Griffin, R.J. Habetz, and R.P. Regan

Experiment: Soybean Tolerance to Pre- and Postemergence Herbicides

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Centennial, 50 lb/A

Planting Date: June 4, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated

Plot Size: 3 rows x 25 ft (treat two rows)

Treated: June 4 (PES); June 26 (EP)

Weed Size: None present

Crop Size: V3 (8 in)

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi (PES);
CO₂ backpack - 20 GPA, 8002 nozzles, 32 psi (EP)

Rated: July 7, July 24

Rainfall: 1st week after planting - 1.2 in; 2nd week - 3.0 in;
3rd week - 5.6 in

Experimental Design: Randomized complete block, 4 replications

Comments: The experimental area was overtreated with Dual at 2.0 lb/A after planting and cultivated to keep weed-free. Data presented in Table 4.

Table 4. Soybean tolerance to preemergence and postemergence herbicides.
Rice Research Station, Crowley, LA. 1987.

Treatment	Rate of application (lb ai/A)	Application time	Phytotoxicity		Mature plant	Mature pod	Yield (bu/A)
			7/7	7/24	ht.	ht.	
			----- (%) -----		----- (in) -----		
Sencor (75% DF)	0.38	PES	5	4	35	8	40.1
	0.76	PES	10	8	35	8	38.9
Scepter (1.5 EC)	0.13	PES	0	1	36	7	40.5
	0.25	PES	5	6	34	7	37.9
Canopy (75% DF)	0.38	PES	18	15	28	6	39.1
	0.76	PES	29	29	26	5	30.2
Scepter/Scepter	0.13/0.13 ^{1/}	PES/EP	11	13	32	6	39.1
	0.13/0.25 ^{1/}	PES/EP	15	16	32	7	36.9
Canopy/Classic	0.38/.008 ^{1/}	PES/EP	28	23	27	5	33.2
(25% DF)							
	0.38/.016 ^{1/}	PES/EP	35	29	24	4	26.2
Command (4 EC)	0.75	PES	0	4	35	8	45.0
	1.50	PES	0	0	35	7	40.2
Lorox (4 F)	0.75	PES	5	5	35	7	41.4
Gemini (60% WP)	0.75	PES	23	19	27	6	35.0
Basagran (4 EC) +	0.50 ^{1/}	EP	11	9	35	7	39.6
Blazer (2 EC)	0.25 ^{1/}	EP					
Blazer	0.50 ^{1/}	EP	13	8	32	6	40.2
Cobra (2 EC)	0.20 ^{1/}	EP	11	6	36	8	40.5
	0.20 ^{1/}	EP	11	9	34	7	38.7
	0.20 ^{2/}	EP	15	9	32	6	38.7
Check	---		0	0	35	8	39.7
LSD (0.05)			5	5	4	1	3.6
CV (%)			29.1	35.8	7.7	13.8	6.8

^{1/} Ag 98 nonionic surfactant added at 0.25% (v/v).

^{2/} Agridex crop oil concentrate added at 1 pt/A.

Experiment: Red Rice Preemergence/Postemergence Test

Location: J.L. Leger Farm, Egan, LA

Variety/Seeding Rate: Ransom, 75 lb/A

Planting Date: June 28, 1987

Row Spacing: 7 in

Plot Size: 7 x 25 ft (treat inside 5 ft)

Treated: June 29 (PES); July 15 (EP)

Weed Size: RR 2 to 3 leaf (some transplanted 6-8 in), AS 1 in, AW 2 in
(some running), EC 2 in

Crop Size: V3 (6 in)

Sprayer: CO₂ backpack - 20 GPA, 8002 nozzles, 32 psi

Rated: July 13, Aug 5

Rainfall: 1st week after planting - 3.3 in

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 5.

Table 5. Red rice (RR), annual sedge (AS), and alligatorweed (AW) control using preemergence and postemergence herbicides. J.L. Leger Farm, Egan, LA. 1987.

Treatment ^{1/}	Rate of application (lb ai/A)	Application time	Weed control			
			7/13	8/5		
			RR	RR	AS	AW
			----- (%) -----			
Partner (74% WDG)	2.50	PES	91	83	95	80
	2.87	PES	94	85	95	85
Command (4 EC)	1.00	PES	75	78	59	10
	1.25	PES	80	81	64	15
Command + Dual (8 EC)	1.0 + 1.0	PES	83	81	94	10
Turbo (8 EC)	2.00	PES	93	90	95	23
Dual + Scepter (1.5 EC)	2.0 + 0.13	PES	91	85	94	79
Lasso MT (4 F) + Scepter	3.0 + 0.13	PES	91	80	94	69
Squadron (2.33 EC)	0.88	PES	91	78	95	81
Prowl (4 EC) + Scepter	1.5 + 0.13	PES	90	78	94	76
Dual + Canopy (75% DF)	2.0 + 0.38	PES	90	89	95	70
Lasso MT + Canopy	3.0 + 0.38	PES	86	84	95	78
Scepter	0.13	PES	86	74	95	64
Scepter/Scepter	0.13/0.13	PES/EP	86	91	95	89
Prowl/Scepter	1.5/0.13	PES/EP	64	79	91	69
Prowl + Pursuit (2 EC)	1.5 + 0.06	PES	88	83	95	61
LSD (0.05)			7	8	7	19
CV (%)			5.8	7.1	5.8	21.9

^{1/} Ag 98 nonionic surfactant added at 0.25% (v/v) to postemergence treatments.

Experiment: Red Rice Postemergence Test

Location: J.L. Leger Farm, Egan, LA

Variety/Seeding Rate: Ransom, 75 lb/A

Planting Date: June 28, 1987

Row Spacing: 7 in

Plot Size: 7 x 20 (treat inside 5 ft)

Treated: July 15

Weed Size: RR 2-3 leaf (some transplanted 6-8 in), AS 1 in, EC 2 in

Crop Size: V3 (6 in)

Sprayer: CO₂ packback - 20 GPA, 8002 nozzles, 32 psi

Rated: August 5

Experimental Design: Randomized complete block, 3 replications

Comments: Data presented in Table 6.

Table 6. Postemergence control of red rice (RR), annual sedge (AS), and eclipta (EC) in soybeans. J.L. Leger Farm, Egan, LA. 1987.

Treatment	Rate of application (lb ai/A)	Weed control - 8/5		
		RR	AS	EC
		------(%)-----		
Classic (25% DF) ^{1/}	0.008	0	95	10
Select (2 EC)	0.075	92	0	0
BAS 517 (1.67 EC)	0.063	67	93	0
	0.075	90	38	3
Fusilade 2000 (1 EC)	0.25	95	0	0
Poast (1.5 EC)	0.38	90	0	0
Pursuit (2 EC) ^{1/}	0.03	82	80	37
	0.06	90	95	77
Scepter (1.5 EC) ^{1/}	0.13	92	85	83
Verdict (2 EC)	0.25	95	0	0
LSD (0.05)		18	22	19
CV (%)		12.9	26.0	51.5

^{1/} Ag 98 nonionic surfactant added at 0.25% (v/v). Agridex crop oil concentrate was added at 1 qt/A to the other treatments.

Experiment: Cinch Test

Location: J.L. Leger Farm, Egan, LA

Variety/Seeding Rate: Ransom, 75 lb/A

Planting Date: June 28, 1987

Row Spacing: 7 in

Plot Size: 7 x 25 ft (treat inside 5 ft)

Treated: June 29 (PES); July 15 (EP)

Weed Size: RR 2-3 leaf (some transplanted 6-8 in), AS 1 in, AW 2-6 in,
EC 2 in

Crop Size: V3 (6 in)

Sprayer: CO₂ backpack - 20 GPA, 8003, 32 psi

Rated: July 13, Aug 5

Rainfall: 1st week after planting - 3.3 in

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 7.

Table 7. Red rice (RR), annual sedge (AS), and alligatorweed (AW) control using Cinch in tank mixtures. J.L. Leger Farm, Egan, LA. 1987.

Treatment ^{1/}	Rate of application (lb ai/A)	Application time	Weed control			
			7/13	8/5		
			RR	RR	AS	AW
----- (%) -----						
Cinch (7 EC) + Lexone (75% DF)	1.0 + 0.33	PES	86	81	94	25
	1.1 + 0.37	PES	91	89	95	48
Cinch + Canopy (75% DF)	1.0 + 0.38	PES	90	91	95	81
Cinch + Gemini (60% WP)	1.0 + 0.75	PES	86	84	95	78
Cinch/Classic (25% DF)	1.0/0.008	PES/EP	84	75	94	64
Cinch + Lexone/Classic	1.0 + 0.33/0.008	PES/EP	89	88	95	68
	1.1 + 0.37/0.008	PES/EP	89	89	95	73
Cinch + Canopy/Classic	1.0 + 0.38/0.008	PES/EP	91	90	95	81
Cinch + Gemini/Classic	1.0 + 0.75/0.008	PES/EP	81	75	94	43
Prowl (4 EC) + Scepter (1.5 EC)/Scepter	1.5 + 0.13/0.13	PES/EP	88	95	95	94
Check	--	--	0	0	0	0
LSD (0.05)			6	6	2	19
CV (%)			4.8	5.7	1.5	21.7

^{1/} Ag 98 nonionic surfactant added at 0.25% (v/v) to the postemergence treatments.

Experiment: BASF Antagonism Test

Location: J.L. Leger Farm

Variety/Seeding Rate: Ransom, 75 lb/A

Planting Date: June 28, 1987

Row Spacing: 7 in

Plot Size: 7 x 20 (treat inside 5 ft)

Treated: July 15 (EP); July 18 (LP)

Weed Size: RR 2-3 leaf (some transplanted 6-8 in), AS 1 in,
AW 2 in (some running),

Crop Size: V3 (6 in) at EP; V4 (7 in) at LP

Sprayer: CO₂ backback - 20 GPA, 8002 nozzles, 32 psi

Rated: Aug 5

Experimental Design: Randomized complete block, 3 replications

Comments: Data presented in Table 8.

Table 8. Red rice (RR), annual sedge (AS), and alligatorweed (AW) control using Poast in tank mixtures and with various additives. J.L. Leger Farm, Egan, LA. 1987.

Treatment	Rate of application (lb ai/A)	Application time	Weed control - 8/5		
			RR	AS	AW
			------(%)-----		
Poast (1.5 EC) + Agridex	0.38 + 1 qt	EP	93	0	0
Poast + Storm (4 EC) + Agridex	0.38 + 0.75 + 1 qt	EP	85	95	28
Poast + Agridex/ Storm + Ag 98	0.38 + 1 qt/ 0.75 + 0.25%	EP/LP	88	90	27
Poast + Storm + Dash	0.38 + 0.75 + 1 qt	EP	87	95	43
Poast Storm + Agridex	0.38 + 0.75 + 1 qt	EP	90	95	33
Poast + Dash/ Storm + Dash	0.38 + 1 qt/ 0.75 + 1 qt	EP/LP	90	93	13
Poast + Storm + Agridex + 32-0-0	0.38 + 0.75 + 1 qt + 1 qt	EP	80	95	40
Poast + Storm + Dash + 32-0-0	0.38 + 0.75 + 1 qt + 1 qt	EP	88	95	30
Poast + Agridex	0.50 + 1 qt	EP	93	27	0
LSD (0.05)			8	17	25
CV (%)			5.9	14.6	67.3

Experiment: General Broadleaf Test

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Wilstar 550, 50 lb/A

Planting Date: May 18, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated prior to planting

Plot Size: 3 rows x 25 ft (treat two rows)

Treated: May 18 (PES); June 2 (EP)

Weed Size: CB 2-4 leaf (2-3 in), PMG 2 leaf (2 in), BYG 3-4 leaf (2 in), SP,
SFMG, RW, MW cotyledons - 1 leaf (1 in)

Crop Size: V2 (4-5 in)

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi

Rated: June 22

Rainfall: 1st week after planting - 2.5 in; 2nd week - 0.4 in;
3rd week - 1.0 in

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 9.

Table 9. Barnyardgrass (BYG), cocklebur (CB), and pitted morningglory (PMG) control, and soybean injury using preemergence and postemergence herbicides. Rice Research Station, Crowley, LA. 1987.

Treatment ^{1/}	Rate of application (lb ai/A)	Application time	Weed control/ Phytotoxicity 6/22			
			BYG	CB	PMG	SB
			----- (%) -----			
Turbo (8 EC)	2.00	PES	95	70	78	13
Partner (74% WDG)	2.50	PES	94	81	89	15
	2.87	PES	95	83	86	18
Squadron (2.33 EC)	0.88	PES	94	81	88	10
Scepter (1.5 EC)	0.13	PES	86	80	84	8
Canopy (75% DF)	0.25	PES	89	85	86	28
	0.38	PES	93	88	89	29
Dual (8 EC) + Canopy	2.0 + 0.38	PES	95	85	86	14
Lasso MT (4 L) + Canopy	2.5 + 0.38	PES	95	88	90	29
Dual + Scepter	2.0 + 0.13	PES	95	80	86	14
Lasso MT + Scepter	2.5 + 0.13	PES	95	75	85	9
Gemini (60% WP)	0.50	PES	95	86	89	20
	0.75	PES	95	89	90	26
Dual + Lexone (75% DF)	2.0 + 0.38	PES	95	64	81	13
Command (4 EC)	1.0	PES	95	74	81	0
Scepter/Scepter	0.13/0.13	PES/EP	94	86	86	10
Canopy/Classic (25% DF)	0.25/0.008	PES/EP	94	91	91	28
Cinch (7 EC) + Canopy	1.0 + 0.38	PES	95	90	91	25
LSD (0.05)			4	6	5	13
CV (%)			2.8	5.0	4.3	55.2

^{1/} Ag 98 nonionic surfactant added at 0.25% (v/v) to all postemergence treatments.

Experiment: Pursuit Test

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Wilstar 550, 50 lb/A

Planting Date: May 18, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated prior to planting

Plot Size: 3 rows x 25 ft (treat two rows)

Treated: May 18 (PES); June 2 (EP)

Weed Size: CB 2-4 leaf (2-3 in), PMG 2 leaf (2 in), BYG 3-4 leaf (2 in), SP,
SFMG, RW, MW cotyledon - 1 leaf (1 in)

Crop Size: V2 (4-5 in)

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi

Rated: June 22

Rainfall: 1st week after planting - 2.5 in; 2nd week - 0.4 in;
3rd week - 1.0 in

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 10.

Table 10. Barnyardgrass (BYG) and cocklebur (CB) control, and soybean (SB) injury using Pursuit preemergence and postemergence. Rice Research Station, Crowley, LA. 1987.

Treatment	Rate of application (lb ai/A)	Application time	Weed control/ Phytotoxicity		
			6/22		
			BYG	CB	SB
			----- (%) -----		
Pursuit (2 EC)	0.063	PES	95	83	3
	0.078	PES	95	84	10
	0.094	PES	95	85	5
Dual (8 EC) + Pursuit	2.0 + 0.063	PES	95	85	5
Lasso MT (4 F) + Pursuit	2.5 + 0.063	PES	95	84	3
Prowl (4 EC) + Pursuit	1.0 + 0.063	PES	95	81	9
Pursuit/Pursuit	0.063/0.063 ^{1/}	PES/EP	95	91	9
Pursuit	0.032 ^{1/}	EP	93	85	0
	0.063 ^{1/}	EP	95	90	4
	0.094 ^{1/}	EP	95	90	3
	0.032 ^{2/}	EP	80	81	1
	0.063 ^{2/}	EP	91	85	1
	0.094 ^{2/}	EP	95	90	1
LSD (0.05)			3	12	5
CV (%)			2.0	10.6	97.5

^{1/} Ag 98 nonionic surfactant added at 0.25% (v/v).

^{2/} 10-34-0 liquid fertilizer added at 1 qt/A.

Experiment: Herbicide Cost Comparison Test

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Wilstar 550, 50 lb/A

Planting Date: May 18, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated prior to planting

Plot Size: 3 rows x 25 ft (treat two rows)

Treated: May 18 (PES); May 28 (VEP); June 2 (EP); June 8 (EP)

Weed Size: PMG and CB cotyledon - 1 leaf at VEP; PMG 2 leaf, CB at 2-4 leaf,
BYG 3-4 leaf at EP; PMG and CB 4 leaf at EP following VEP

Crop Size: V1 at VEP, V2 (4-5 in) at EP, V4 (6-8 in) at EP following VEP

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi

Rated: June 22

Rainfall: 1st week after planting - 2.5 in; 2nd week - 0.4 in;
3rd week - 1.0 in

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 11.

Table 11. Barnyardgrass (BYG), cocklebur (CB), and pitted morningglory (PMG) control and soybean (SB) injury using preemergence and postemergence herbicides. Rice Research Station, Crowley, LA. 1987.

Treatment ^{1/}	Rate of application (lb ai/A)	Application time	Weed control/ Phytotoxicity 6/22			
			BYG	CB	PMG	SB
			----- (%) -----			
Dual (8 EC)	2.0	PES	94	0	0	3
Dual + Scepter (1.5 EC)	2.0 + 0.13	PES	95	83	85	11
Dual + Scepter/Scepter	2.0 + 0.13/0.13	PES/EP	95	89	90	13
Dual + Canopy (75% DF)	2.0 + 0.38	PES	95	91	91	21
Dual + Canopy/Classic (25% DF)	2.0 + 0.38/0.008	PES/EP	95	95	95	24
Dual/Scepter	2.0/0.13	PES/EP	95	86	83	5
Dual/Classic	2.0/0.008	PES/EP	95	93	91	13
Dual/Stam (4 EC)	2.0/0.75	PES/EP	94	85	86	8
Dual/Basagran (4 EC) + Blazer (2 EC)/Basagran + Blazer	2.0/0.19 + 0.06/ 0.19 + 0.06	PES/VEP/ EP	95	79	84	5
Basagran + Blazer + Fusilade 2000 (1 EC)/Basagran + Blazer + Fusilade 2000	0.19 + 0.06 + 0.06/ 0.19 + 0.06 + 0.06	VEP/EP	95	81	85	1
AC 263,222 (2 EC)	0.009	VEP	94	74	79	10
	0.036	VEP	95	80	85	35
Scepter + AC 263,222	0.13 + 0.009	VEP	95	85	85	16
	0.13 + 0.036	VEP	95	90	89	50
Fusilade 2000 + Reflex (2 EC)	0.19 + 0.31	EP	95	89	89	1
LSD (0.05)			NS	5	4	9
CV (%)			1.2	4.3	3.7	45.6

^{1/} Ag 98 nonionic surfactant added at 0.25% (v/v) to all postemergence treatments.

Experiment: Wild Poinsettia Preemergence/Postemergence Test

Location: J. Heinen Farm, Crowley, LA

Soil Type: Crowley silt loam

Variety/Seeding Rate: Wilstar 550, 50 lb/A

Planting Date: May 19, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated prior to planting

Plot Size: 3 rows x 25 ft (treat two rows)

Treated: May 19 (PPI/PES); June 8 (EP)

Weed Size: WP 2-3 in (most at 3 in) 3-4 leaf, PMG 3 leaf, DF 2-3 leaf

Crop Size: V4 (5-6 in)

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi

Rated: June 24

Rainfall: 1st week after planting - 0.8 in; 2nd week - 0.4 in;
3rd week - 0.9 in

Experimental Design: Randomized complete block, 4 replications

Comments: Preplant treatments were incorporated using a field cultivator.
Data presented in Table 12.

Table 12. Broadleaf signalgrass (BSG), wild poinsettia (WP), pitted morningglory (PMG), and dayflower (DF) control, and soybean injury using preemergence and postemergence herbicide treatments. J. Heinen Farm, Crowley, LA. 1987.

Treatment ^{1/}	Rate of application (lb ai/A)	Application time	Weed control/Phytotoxicity 6/24				
			BSG	WP	PMG	DF	SB
			----- (%) -----				
Squadron (2.33 EC)	0.88	PPI	86	84	78	73	8
Salute (4 EC)	1.13	PPI	80	78	76	38	5
Salute + Scepter (1.5 EC)	1.13 + 0.09	PPI	84	89	84	68	10
Salute + Command (4 EC)	1.13 + 0.25	PPI	90	86	83	65	8
Turbo (8 EC)	2.00	PPI	94	79	74	78	6
Turbo + Command	2.0 + 0.25	PPI	93	86	78	64	4
Command	0.75	PPI	94	93	78	70	1
	1.00	PPI	90	94	78	69	3
	0.75	PES	95	95	81	76	0
	1.00	PES	95	95	78	79	3
Partner (74% WDG)	2.50	PPI	89	89	80	83	6
Canopy (75% DF)	0.25	PPI	59	76	75	63	4
	0.38	PPI	75	81	75	61	0
Scepter	0.125	PPI	84	88	83	76	1
Scepter/Scepter	0.13/0.13	PPI/EP	90	95	88	83	1
Canopy/Classic (25% DF)	0.25/0.008	PPI/EP	55	84	81	75	0
Gemini (60% WP)	0.50	PES	76	73	74	71	1
Dual (8 EC) + Sencor (75% DF)	2.0 + 0.25	PPI	93	84	74	75	8
Pursuit (2 EC)	0.06	PPI	85	80	73	73	1
Pursuit/Pursuit	0.06/0.06	PPI/EP	95	95	81	81	1
LSD (0.05)			16	8	8	18	6
CV (%)			13.3	6.2	7.4	17.6	129.4

^{1/} Ag 98 nonionic surfactant added at 0.25% (v/v) to all postemergence treatments.

Experiment: Wild Poinsettia Postemergence Test

Location: J. Heinen Farm, Crowley, LA

Soil Type: Crowley silt loam

Variety/Seeding Rate: Wilstar 550, 50 lb/A

Planting Date: May 19, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated prior to planting

Plot Size: 3 rows x 25 ft (treat two rows)

Treated: June 8

Weed Size: WP 2-3 in (most at 3 in and 3-4 leaf), PMG 3 leaf

Crop Size: V4 (5-6 in)

Sprayer: Tractor compressed air - 20 GPA, 11002 nozzles, 25 psi

Rated: June 24

Experimental Design: Randomized complete block, 4 replications

Comments: Experimental area was overtreated with Dual at 2 lb/A after planting. Data presented in Table 13.

Table 13. Wild poinsettia (WP) and pitted morningglory (PMG) control and soybean injury using postemergence herbicides with various additives. J. Heinen Farm. Crowley, LA. 1987.

Treatment	Rate of application (lb ai/A)	Weed control/phytotoxicity		
		6/24		
		WP	PMG	SB
		------(%)-----		
Blazer (2 EC) + Ag 98	0.25 + 0.25%	95	83	5
	0.38 + 0.25%	95	86	0
	0.50 + 0.25%	95	94	10
Blazer + 32-0-0	0.25 + 1 qt/A	91	80	1
Tackle (2 EC) + Ag 98	0.38 + 0.25%	95	91	9
Storm (4 EC) + Ag 98	0.75 + 0.25%	94	85	5
Cobra (2 EC) + Ag 98	0.20 + 0.25%	95	95	19
Cobra + Agridex	0.20 + 1 pt/A	95	95	29
Cobra + Agridex	0.15 + 1 pt/A	95	94	25
Cobra + Agridex	0.20 + 0.5 pt/A	95	95	24
Reflex (2 EC) + Ag 98	0.25 + 0.25%	95	88	0
	0.31 + 0.25%	94	84	0
Scepter (1.5 EC) + Ag 98	0.13 + 0.25%	94	89	0
Scepter + 32-0-0	0.13 + 1 qt/A	81	84	1
Classic (25% DF) + Ag 98	.008 + 0.25%	91	84	5
Classic + 32-0-0	.008 + 1 qt/A	88	84	1
Pursuit (2 EC) + Ag 98	.032 + 0.25%	83	73	0
	0.063 + 0.25%	93	78	5
Pursuit + 11-37-0	.063 + 1 qt/A	75	78	3
Storm + 32-0-0	0.75 + 1 qt/A	90	86	3
LSD (0.05)		4	6	8
CV (%)		3.1	4.8	78.7

Experiment: Wild Poinsettia Postemergence Rate-Timing Test

Location: J. Heinen Farm, Crowley, LA

Soil Type: Crowley silt loam

Variety/Seeding Rate: Wilstar 550, 50 lb/A

Planting Date: May 19, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated prior to planting

Plot Size: 3 rows x 25 ft (treat two rows)

Treated: June 3 (EP); June 15 (LP)

Weed Size: WP 3 leaf (1-2 in) at EP; WP 5-6 leaf (2-4 in) at LP

Crop Size: V1 (4-5 in) at EP; V4-V5 (8 in) at LP

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi (EP);
CO₂ backpack - 20 GPA, 8002 nozzles, 32 psi (LP)

Rated: June 24, July 14

Experimental Design: Randomized complete block, 4 replications

Comments: Experimental area was overtreated with Dual at 2.0 lb/A after planting. Data presented in Table 14.

Table 14. Postemergence control of wild poinsettia (WP) and soybean (SB) injury as influenced by herbicide rate and timing of application. J. Heinen Farm, Crowley, LA. 1987.

Treatment ^{1/}	Rate of application (lb ai/A)	Application time	Weed control/phytotoxicity			
			6/24		7/14	
			WP	SB	WP	SB
			----- (%) -----			
Scepter (1.5 EC)	0.13	EP	95	5	95	6
	0.19	EP	98	8	96	6
Classic (25% DF)	0.008	EP	93	5	90	5
	0.012	EP	95	15	94	14
Blazer (2 EC)	0.38	EP	96	6	93	4
	0.50	EP	99	16	95	13
Scepter	0.13	LP	80	0	84	1
	0.19	LP	83	0	88	1
Classic	0.008	LP	84	0	89	1
	0.012	LP	83	3	90	1
Blazer	0.38	LP	84	0	80	1
	0.50	LP	89	9	84	1
Check	--	--	0	0	0	0
LSD (0.05)			5	6	6	6
CV (%)			4.2	74.7	5.3	94.3

^{1/} Ag 98 nonionic surfactant added at 0.25% (v/v) to all postemergence treatments.

Experiment: Sicklepod Preemergence/Postemergence Test

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Wilstar 550, 50 lb/A

Planting Date: May 18, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated prior to planting

Plot Size: 3 rows x 25 ft (treat two rows)

Treated: May 19 (PES); June 19 (EP)

Weed Size: SP cotyledon - 5 in (most at 3 in), BSG 1-6 in (most at 2-3 in)

Crop Size: V6-V7 (12 in)

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi (PES);
CO₂ backpack - 20 GPA, 8002 nozzles, 32 psi (EP)

Rated: June 24

Rainfall: 1st week after planting - 1.3 in; 2nd week - 0.7 in;
3rd week - 1.6 in

Experimental Design: Randomized complete block, 4 replications

Comments: The postemergence treatments were delayed due to rain and,
consequently, weed size was quite variable. Data presented in Table 15.

Table 15. Broadleaf signalgrass (BSG) and sicklepod (SP) control, and soybean injury using preemergence and postemergence herbicides. Rice Research Station, Crowley, LA. 1987.

Treatment ^{1/}	Rate of application (lb ai/A)	Application time	Weed control/ Phytotoxicity		
			6/24		
			BSG	SP	SB
			----- (%) -----		
Turbo (8 EC)	2.00	PES	94	80	0
Partner (74% WDG)	2.50	PES	94	86	4
	2.87	PES	94	88	6
Squadron (2.33 EC)	0.88	PES	84	80	9
Scepter (1.5 EC)	0.13	PES	81	78	3
Canopy (75% DF)	0.25	PES	78	84	11
	0.38	PES	85	85	6
Lasso MT (4 F) + Canopy	2.5 + 0.38	PES	94	89	16
Dual + Scepter	2.0 + 0.13	PES	95	83	6
Lasso MT + Scepter	2.5 + 0.13	PES	91	81	11
Gemini (60% WP)	0.50	PES	89	85	16
Command (4 EC)	1.00	PES	91	74	0
Dual + Lexone (75% DF)	2.0 + 0.38	PES	74	61	8
Prowl (4 EC) + Scpeter	1.0 + 0.13	PES	89	81	15
Scepter/Scepter	0.13/0.13	PES/EP	88	85	8
Canopy/Classic (25% DF)	0.25/0.008	PES/EP	81	85	14
Cinch (7 EC) + Canopy	1.0 + 0.38	PES	95	85	14
Pursuit (2 EC)	0.063	PES	94	68	0
Pursuit/Pursuit	0.063/0.063	PES/EP	95	74	3
LSD (0.05)			NS	14	7
CV (%)			11.6	12.5	67.3

^{1/} Ag 98 nonionic surfactant added at 0.25% (v/v) to all postemergence treatments.

Experiment: Sicklepod Postemergence Test

Location: Rice Research Station, Crowley, LA

Soil Type: Crowley silt loam

Variety/Seeding Rate: Wilstar 550, 50 lb/A

Planting Date: May 18, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated prior to planting

Plot Size: 3 rows x 25 ft (treat two rows)

Treated: June 20

Weed Size: SP 2-4 inch (most at 2 leaf and a few 6 in)

Crop Size: V7 (12-15 in)

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi

Rated: July 2

Experimental Design: Randomized complete block, 4 replications

Comments: The postemergence treatments were delayed due to rain and, consequently, weed size was quite variable. Data presented in Table 16.

Experiment: Jointvetch Postemergence Test

Location: Rice Research Station, Crowley, LA

Soil Type: Crowley silt loam

Variety/Seeding Rate: Wilstar 550, 50 lb/A

Planting Date: May 18, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated prior to planting

Plot Size: 3 rows x 25 ft (treat two rows)

Treated: June 20

Weed Size: JV 1-7 in (most at 5 in)

Crop Size: V7 (12-15 in)

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi

Rated: July 2

Experimental Design: Randomized complete block, 4 replications

Comments: The postemergence treatments were delayed due to rain and, consequently, weed size was quite variable. Data presented in Table 16.

Table 16. Sicklepod (SP) and jointvetch (JV) control, and soybean injury using postemergence herbicides with various additives. Rice Research Station, Crowley, LA. 1987.

Treatment	Rate of application (lb ai/A)	Weed control/phytotoxicity			
		7/2		SB ^{1/}	
		SP	JV	SB ^{1/}	SB ^{1/}
Cobra (2 EC) + Ag 98	0.20 + 0.25%	--	86	--	15
Cobra + Agridex	0.20 + 1 pt/A	--	84	--	14
Cobra + Agridex	0.15 + 1 pt/A	74	88	10	14
Blazer + Ag 98	0.50 + 0.25%	75	95	4	6
Reflex (2 EC) + Ag 98	0.25 + 0.25%	79	95	4	8
	0.31 + 0.25%	83	95	0	5
Scepter (1.5 EC) + Ag 98	0.13 + 0.25%	80	84	0	0
Scepter + 32-0-0	0.13 + 1 qt/A	79	78	3	0
Classic (25% DF) + Ag 98	.008 + 0.25%	80	88	8	3
Classic + 32-0-0	.008 + 1 qt/A	74	80	3	6
Pursuit (2 EC) + Ag 98	.032 + 0.25%	73	76	0	0
	.063 + 0.25%	70	80	9	3
Pursuit + 11-37-0	.063 + 1 qt/A	80	76	0	8
Storm + 32-0-0	0.75 + 1 qt/A	78	80	3	0
LSD (0.05)		10	12	5	5
CV (%)		9.5	10.8	75.8	87.3

^{1/} Values represent two separate experiments.

Experiment: Jointvetch and Redweed Preemergence/Postemergence Test

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Wilstar 550, 50 lb/A

Planting Date: May 18, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated prior to planting

Plot Size: 3 rows x 25 ft (treat two rows)

Treated: May 19 (PES); June 19 (EP)

Weed Size: BSG 2-4 in, JV 2-6 in (most at 3-4 in), RW 1 in

Crop Size: V7 (12 in)

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi (PES);
CO₂ packback - 20 GPA, 8002 nozzles, 32 psi (EP)

Rated: June 24

Rainfall: 1st week after planting - 1.3 in; 2nd week - 0.7 in;
3rd week - 1.6 in

Experimental Design: Randomized complete block, 4 replications

Comments: The postemergence treatments were delayed due to rain and,
consequently, weed size was quite variable. Data presented in Table 17.

Table 17. Broadleaf signalgrass (BSG), jointvetch (JV), and redweed (RW) control, and soybean injury using preemergence and postemergence herbicides. Rice Research Station, Crowley, LA. 1987.

Treatment ^{1/}	Rate of application (lb ai/A)	Application time	Weed control/ Phytotoxicity			
			6/24			
			BSG	JV	RW	SB
			----- (%) -----			
Turbo (8 EC)	2.00	PES	95	91	85	0
Partner (74% WDG)	2.50	PES	93	78	78	6
	2.87	PES	91	78	78	5
Squadron (2.33 EC)	0.88	PES	81	68	78	9
Scepter (1.5 EC)	0.13	PES	79	66	79	4
Canopy (75% DF)	0.25	PES	81	89	84	6
	0.38	PES	85	90	88	11
Lasso MT (4 F) + Canopy	2.5 + 0.38	PES	95	93	93	16
Dual + Scepter	2.0 + 0.13	PES	95	78	80	11
Lasso MT + Scepter	2.5 + 0.13	PES	93	79	79	8
Gemini (60% WP)	0.50	PES	94	90	89	5
Command (4 EC)	1.00	PES	95	92	88	0
Dual + Lexone (75% DF)	2.0 + 0.38	PES	95	86	85	0
Prowl (4 EC) + Scepter	1.0 + 0.13	PES	84	79	81	11
Scepter/Scepter	0.13/0.13	PES/EP	84	80	85	9
Canopy/Classic (25% DF)	0.25/0.008	PES/EP	85	94	91	8
Cinch (7 EC) + Canopy	1.0 + 0.38	PES	95	91	86	6
Pursuit (2 EC)	0.063	PES	90	71	81	0
Pursuit/Pursuit	0.063/0.063	PES/EP	88	76	86	8
LSD (0.05)			6	11	7	7
CV (%)			4.9	9.3	6.2	76.5

^{1/} Ag 98 nonionic surfactant added at 0.25% (v/v) to all postemergence treatments.

RICE WEED CONTROL RESEARCH

J.L. Griffin, R.J. Habetz, and R.P. Regan

Experiment: Advanced Herbicide Test

Location: McDonald Farm (E. Lounsberry), Lake Arthur, LA

Soil: Silt loam

Variety/Seeding Rate: Lemont, 120 lb/A

Planting Date: Apr 5, 1987

Planting Method: Water-seeded

Flushed: Apr 16, Apr 19, Apr 27, and May 2

Permanent Flood: May 16

Plot Size: 7 x 25 ft

Treated: May 1 (EP); May 11 (PrF)

Weed Size: BYG 3-4 lf (some at 5 leaf), EC 3 lf (1 in), JV 1 lf (1 in),
AS (1 in), RW/MW cotyledon-1 lf (1 in) at EP; BYG 5-6 lf early tiller
(some 6-8 in), EC 1-4 in, JV 2-4 in, AS 4 in at PrF

Crop Size: 3-4 leaf (4 in) at EP; 5 lf (early tiller) at PrF

Sprayer: Tractor - 20 GPA, 8003 nozzles, 26 psi (EP);
CO₂ backpack - 20 GPA, 8002 nozzles, 32 psi (PrF)

Rated: May 14, June 18

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 18.

Table 18. Barnyardgrass (BYG), Eclipta (EC), and annual sedge (AS) control and rice injury following several postemergence herbicide treatments. E. Lounsberry Farm, Lake Arthur, LA. 1987.

Treatment ^{1/}	Rate of application (lb ai/A)	Application time	Weed control/phytotoxicity				
			5/14			6/18	
			BYG	EC	AS	BYG	Rice
------(%)-----							
BAS 514 (50% WP) + BAS 090	0.25 + 1 qt	EP	95	95	85	95	0
BAS 514	0.25	EP	94	91	83	95	0
BAS 514 + BAS 090	0.25 + 1 qt	PrF	33	81	50	91	0
Stam (4 EC)	3.0	EP	79	74	79	83	0
Stam/Stam	3.0/3.0	EP/PrF	95	95	95	95	0
Stam + Bolero (8 EC)	3.0/3.0	EP	90	84	90	89	0
Stam + Buctril (2 EC)	3.0 + 0.38	EP	84	95	89	90	5
Stam + Garlon (3 EC)	3.0 + 0.25	EP	84	95	93	89	13
	3.0 + 0.38	PrF	84	89	84	86	21
Stam/Garlon	3.0/0.38	EP/PrF	88	91	83	91	33
Stam/Whip	3.0/0.15	EP/PrF	90	79	75	95	18
Whip (1 EC) + Garlon	0.15 + 0.38	PrF	33	80	43	95	48
Whip + Buctril	0.15 + 0.38	PrF	34	86	38	93	15
Garlon	0.38	PrF	30	81	59	0	31
Check	--	--	0	0	0	0	0
LSD (0.05)			10	6	12	6	13
CV (%)			10.7	4.8	11.3	5.4	77.2

Experiment: Graminicide Combination Test

Location: McDonald Farm (E. Lounsberry), Lake Arthur, LA

Soil: Silt loam

Variety/Seeding Rate: Lemont, 120 lb/A

Planting Date: Apr 5, 1987

Planting Method: Water-seeded

Flushed: Apr 16, Apr 19, Apr 27, and May 2

Permanent Flood: May 16

Plot Size: 7 x 25 ft

Treated: May 1 (EP); May 11 (PrF)

Weed Size: BYG 3-4 lf (some at 5 leaf), EC 3 lf (1 in), JV 1 lf (1 in),
AS (1 in), RW/MW cotyledon-1 lf (1 in) at EP; BYG 5-6 lf early tiller
(some 6-8 in), EC 1-4 in, JV 2-4 in, AS 4 in at PrF

Crop Size: 3-4 leaf (4 in) at EP; 5 lf (early tiller) at PrF

Sprayer: Tractor - 20 GPA, 8003 nozzles, 26 psi (EP);
CO₂ backpack - 20 GPA, 8002 nozzles, 32 psi (PrF)

Rated: May 14, June 18

Experimental Design: Randomized complete block, 4 replications

Comments: Chlorosis on rice was noted 5 days after the PrF treatments of
Buctril tank-mixed with Poast, Whip, and Verdict. This was not noted for
the Garlon or BAS 514 tank mixtures. Data presented in Table 19.

Table 19. Barnyardgrass (BYG), eclipta (EC), and annual sedge (AS) control, and rice injury following several herbicide treatments. E. Lounsberry Farm, Lake Arthur, LA. 1987.

Treatment ^{1/}	Rate of application (lb ai/A)	Application time	Weed control/phytotoxicity				
			5/14			6/18	
			BYG	EC	AS	BYG	Rice
----- (%) -----							
Stam (4 EC)/Stam	3.0/3.0	EP/PrF	95	93	98	95	0
Stam/Whip (1 EC)	3.0/0.15	EP/PoF	85	79	84	93	13
Whip	0.15	PrF	0	0	0	95	20
Whip + Garlon (3EC)	0.15 + 0.38	PrF	0	84	58	95	34
Whip + BAS 514 (50% WP)	0.15 + 0.25	PrF	23	84	33	93	19
Whip + Buctril (2 EC)	0.15 + 0.38	PrF	41	91	50	95	13
Stam/Verdict (50% WDG)	3.0/0.06	EP/PoF	83	63	71	90	14
Verdict	0.06	PrF	0	0	0	95	23
Verdict + Garlon	0.06 + 0.38	PrF	7.5	86	35	89	35
Verdict + BAS 514	0.06 + 0.25	PrF	0	84	38	95	19
Verdict + Buctril	0.06 + 0.38	PrF	20	85	38	94	14
Stam/Poast (1.5 EC)	3.0/0.10	EP/PoF	83	78	86	86	16
Poast	0.10	PrF	0	0	0	95	18
Poast + Garlon	0.10 + 0.38	PrF	20	84	48	94	34
Poast + BAS 514	0.10 + 0.25	PrF	13	84	43	95	16
Poast + Buctril	0.10 + 0.38	PrF	50	89	38	95	18
Check	--	--	0	0	0	0	0
LSD (0.05)			15	7	20	5	11
CV (%)			34.3	7.6	33.4	4.3	44.5

^{1/} X-77 nonionic surfactant added at 0.25% (v/v) to the Verdict treatments and Agridex COC added at 1 qt/A to the Poast treatments.

Experiment: BAS 514 Postemergence Test

Location: McDonald Farm (E. Lounsberry), Lake Arthur, LA

Soil: Silt loam

Variety/Seeding Rate: Lemont, 120 lb/A

Planting Date: Apr 5, 1987

Planting Method: Water-seeded

Flushed: Apr 16, Apr 19, Apr 27, and May 2

Permanent Flood: May 16

Plot Size: 7 x 25 ft

Treated: May 1 (EP); May 11 (PrF)

Weed Size: BYG 3-4 lf (some at 5 leaf), EC 3 lf (1 in), JV 1 lf (1 in),
AS (1 in), RW/MW cotyledon-1 lf (1 in) at EP; BYG 5-6 lf early tiller
(some 6-8 in), EC 1-4 in, JV 2-4 in, AS 4 in at PrF

Crop Size: 3-4 lf (4 in) at EP; 5 lf (early tiller) at PrF

Sprayer: Tractor - 20 GPA, 8003 nozzles, 26 psi (EP);
CO₂ backpack - 20 GPA, 8002 nozzles, 32 psi (PrF)

Rated: May 14, June 18

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 20.

Table 20. Barnyardgrass (BYG), eclipta (EC), and annual sedge (AS) control following several herbicide treatments in rice. E. Lounsberry Farm, Lake Arthur, LA. 1987.

Treatment	Rate of application (lb ai/A)	Application time	Weed control			
			5/14			6/18
			BYG	EC	AS	BYG
			----- (%) -----			
BAS 514 (50% WP)	0.15	EP	85	82	58	82
	0.20	EP	93	91	79	95
	0.25	EP	95	93	80	94
BAS 514 + BAS 090	0.15 + 1 qt	EP	93	91	70	93
	0.20 + 1 qt	EP	94	95	85	95
	0.25 + 1 qt	EP	95	95	85	95
BAS 514 + Stam (4 EC)						
+ BAS 090	0.15 + 2.0 + 1 qt	EP	95	95	83	93
	0.20 + 2.0 + 1 qt	EP	95	95	86	95
	0.25 + 2.0 + 1 qt	EP	95	95	85	95
BAS 514 + Bolero						
(8 EC) + BAS 090	0.15 + 3.0 + 1 qt	EP	95	95	88	95
	0.20 + 3.0 + 1 qt	EP	95	95	86	95
	0.25 + 3.0 + 1 qt	EP	95	95	89	95
Stam	3.0	EP	83	76	68	83
Stam/Stam	3.0/3.0	EP/PrF	93	85	91	91
Stam + Bolero	3.0 + 3.0	EP	91	86	94	85
Check	--	--	0	0	0	0
LSD (0.05)			5	5	13	4
CV (%)			4.0	4.3	11.6	3.6

Experiment: Water-Seeded Test #2 (brief drainage)

Location: E. Lounsberry Farm, Lake Arthur, LA

Soil: Silt loam

Variety/Seeding Rate: Lemont, 120 lb/A

Planting Date: Apr 7, 1987

Planting Method: Water-seeded

Permanent Flood: Apr 16

Plot Size: 7 x 25 ft

Treated: Apr 1 (PPI); May 14 (PoF)

Weed Size: PW 3-5 leaf (2-3 inches in height) at PoF

Crop Size: 12 in (early tiller) at PoF

Sprayer: Tractor - 20 GPA, 8003 nozzles, 26 psi (PPI);
CO₂ backpack - 20 GPA, 8002 nozzles, 32 psi (PoF)

Rated: June 18

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 21. Plots were drained on May 11 to facilitate herbicide application. At the time of application, soil was saturated and water was standing in some areas. The Stam and Bucril tank mix was extremely phytotoxic. This may have been due to the fact that rice was succulent and elongated after emergence through the flood.

Table 21. Influence of several herbicide treatments on rice injury. E.
Lounsberry Farm, Lake Arthur, LA. 1987.

Treatment ^{1/}	Rate of application (1b ai/A)	Application time	Rice injury 6/18 ----(%)----
Ordram (8 EC)	4.0	PPI	0
Ordram/BAS 514 (50% WP)	4.0/0.25	PPI/PoF	0
	4.0/0.38	PPI/PoF	0
Ordram/Crossbow (3 EC)	4.0/0.19	PPI/PoF	3
	4.0/0.38	PPI/PoF	8
Ordram/Stam (4 EC) +			
Garlon (3 EC)	4.0/3.0 + 0.25	PPI/PoF	6
Ordram/Garlon	4.0/0.38	PPI/PoF	16
Ordram/Stam +			
Buctril (2 EC)	4.0/0.30 + 0.38	PPI/PoF	36
Ordram/Buctril	4.0/0.38	PPI/PoF	3
Ordram/Stam +			
Basagran (4 EC)	4.0/3.0 + 0.75	PPI/PoF	0
Ordram/M60	4.0/0.86	PPI/PoF	3
LSD (0.05)			11
CV (%)			110.4

Experiment: Effect of Poast and Whip on Rice

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Lemont, 100 lb/A

Planting Date: Apr 8, 1987

Planting Method: Drilled 7 in

Flushed: Apr 14, Apr 20, Apr 24, and Apr 30

Permanent Flood: May 21

Fertilizer: 60-60-60 (N-P₂O₅-K₂O) banded at planting; 75-0-0 (21%) on May 19

Plot Size: 4 x 30 ft

Treated: May 8 (EP); May 17 (PrF)

Weed Size: BYG 2-3 leaf, PNS 2-3 inch, some AW (running) at EP

Crop Size: 3 leaf at EP; 4 leaf at PrF

Sprayer: CO₂ backpack - 15 GPA, 110015 nozzles, 32 psi

Rated: June 1, June 25

Harvested: Aug. 21

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 22. Two hours following the EP application 0.1 in of rain was received. A new flush of grass weeds were present when the PrF applications were made. Furadan was applied on June 1.

Table 22. Influence of Poast and Whip on rice phytotoxicity, weed control, mature plant height, panicle numbers, yield, and yield components. Rice Research Station, Crowley, LA. 1987.

Treatment	Rate of application (lb ai/A)	Application time	Phytotoxicity/ Weed Control										500- seed weight (g)	Yield (lb/A)	Head rice Moisture ----- (%) -----										
			6/1		6/25		Panicles/ 3 ft		Plant ht (in)	Seed/ panicle (no.)	500- seed (g)														
			Rice		DS		Rice																		
			BYG	PNS	BYG	PNS	BYG	PNS								BYG	PNS	BYG	PNS	BYG	PNS				
			----- (%) -----																						
Stam (4 EC)/Stam	3.0/3.0	EP/PrF	0	95	94	90	0	51	33	124	13.0	7165	54	14.3											
Stam/Poast (1.5 EC)	3.0/0.10	EP/PrF	31	95	70	53	14	47	31	115	12.7	6462	60	14.7											
	3.0/0.15	EP/PrF	45	95	46	43	21	45	30	111	12.7	5312	62	15.6											
Stam/Whip (1 EC)	3.0/0.15	EP/PrF	36	95	95	40	20	46	31	125	12.8	6262	58	14.7											
LSD (0.05)			7	NS	NS	15	7	NS	1	NS	NS	NS	3	0.7											
CV (%)			14.8	0	42.5	16.6	29.7	13.0	2.7	6.3	1.7	13.0	3.2	2.9											

Experiment: Graminicide Efficacy/Tolerance Test

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Lemont, 110 lb/A

Planting Date: Apr 14, 1987

Planting Method: Drilled 7 in

Flushed: Apr 20, Apr 30

Permanent Flood: May 22

Fertilizer: 60-60-60 (N-P₂O₅-K₂O) banded at planting; 100-0-0 (21%) on May 21

Plot Size: 4 x 25 ft

Treated: May 21 (PrF)

Weed Size: BYG 1-3 tillers and 4-6 in (some with 5-6 tillers 7-8 in) at PrF

Crop Size: 4-5 leaf (some with 1 tiller) at PrF

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi

Rated: June 1, June 25

Harvested: Aug 28

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 23. The experimental area was overtreated with Garlon at 0.25 lb/A on May 18. Excellent palmleaf morningglory control was observed.

Table 23. Annual grass (AG) control and rice phytotoxicity, mature plant height, and yield as influenced by postemergence grass herbicide treatments. Rice Research Station, Crowley, LA. 1987.

Treatment ^{1/}	Rate of application (lb ai/A)	Phytotoxicity/ weed control			Mature plant height (in)	Yield (lb/A)
		6/1	6/25			
		Rice	Rice	AG		
		-----	-----	-----		
Whip (1 EC)	0.15	55	28	98	85	5564
Poast (1.5 EC) + Agridex	0.10 + 1 qt	48	16	100	86	5402
Verdict (50% WDG) + X77	0.06 + 0.25%	35	13	84	85	5306
Select (2 EC) + Agridex	0.04 + 1 qt	75	45	100	86	4408
	0.08 + 1 qt	88	51	100	86	4342
Fusilade 2000 (1 EC) + X77	0.04 + 0.25%	53	18	96	86	5674
	0.08 + 0.25%	79	46	100	87	4632
DPX Y6202 (0.75 EC) + X77	0.02 + 0.25%	83	76	94	87	2716
	0.04 + 0.25%	95	99	100	0	0
Garlon (3 EC)	0.25	25	20	44	83	4963
Check	--	0	0	0	83	4335
LSD (0.05)		11	20	19	4	1203
CV (%)		13.3	37.0	15.5	3.4	19.4

^{1/} All treatments applied preflood.

Experiment: Rice Varietal Tolerance to Whip, Poast, and Verdict #1

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Skybonnet, Tebonnet, 100 lb/A

Planting Date: Apr 7, 1987

Planting Method: Drilled 7 in

Flushed: Apr 14, Apr 20, Apr 24, Apr 30

Permanent Flood: May 20

Fertilizer: 60-60-60 (N-P₂O₅-K₂O) broadcasted and incorporated prior to planting; 75-0-0 (21%) on May 19

Plot Size: 4 x 25 ft

Treated: May 15 (PrF); June 15 (PoF)

Weed Size: None present

Crop Size: 4-5 leaf (some with 1 tiller) at PrF; 4 days prior to green ring at PoF

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi (PrF);
CO₂ backpack - 15 GPA, 110015, 32 psi (PoF)

Rated: May 28, July 2, Sept 10

Harvested: Aug 13

Experimental Design: Split plot (varieties as whole plots and herbicide treatments as subplots) 4 replications

Comments: Data presented in Table 24. Two applications of Stam were made to keep the area weed free. Rainfall was received 8 hours after the EP application and 5 hours after the LP application. Where herbicide treatments caused stunting and/or stand reduction, duck salad and redstem intrusion occurred. Furan was applied on June 1 and Benlate was applied on June 13.

Table 24. Influence of Whip, Poast, and Verdict on rice phytotoxicity, heading, mature plant height, yield, and ratooning of Skybonnet and Tebonnet rice. Rice Research Station, Crowley, LA. 1987.^{1/}

Treatment	Rate of application -(lb ai/A)-	Application time ^{2/}	Phytotoxicity		Heading	Plant ht. (in)	Yield (lb/A)	Ratoon ^{3/} rating
			5/28	7/2				
			----- (%) -----		(%)			
Check	--	--	0e ^{4/}	0e	96a	123a	8002a	8.8a
Whip	0.15	PrF	36c	9de	70b	121ab	7964a	8.8a
	0.30	PrF	56b	23b	34d	121ab	7648ab	7.9a
	0.15	PoF	0e	5de	94a	112cd	7749ab	8.3a
	0.30	PoF	0e	6de	91a	106e	7012bc	8.1a
Poast	0.10	PrF	20d	6de	86ab	121ab	8330a	8.6a
	0.20	PrF	41c	13bcd	38cd	118b	7668ab	7.9a
	0.10	PoF	0e	9de	29d	110d	6385cd	8.4a
	0.20	PoF	0e	12cd	1e	105e	6030de	5.6b
Verdict	0.06	PrF	42c	13bcd	53c	119ab	7927a	8.1a
	0.13	PrF	77a	45a	10e	115c	5303e	6.2b
	0.06	PoF	0e	11cd	6e	101f	4477f	5.6b
	0.13	PoF	0e	19bc	0e	101f	2981g	4.4c
CV (%)			33.6	70.5	32.6	2.7	10.5	13.7

^{1/} Data represent an average across rice varieties.

^{2/} PrF = preflood with rice at 4-5 leaf; PoF = postflood with rice 4 days prior to green ring.

^{3/} Ratings based on a scale of 0 = no regrowth and 10 = maximum regrowth.

^{4/} Means followed by the same letter within each column are not significantly different at the 5% level using Duncan's multiple range test.

Experiment: Rice Varietal Tolerance to Whip, Poast, and Verdict #2

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Lemont, Gulfmont, Mars, Mercury, 100 lb/A

Planting Date: Apr 7, 1987

Planting Method: Drilled 7 in

Flushed: Apr 14, Apr 20, Apr 24, Apr 30

Permanent Flood: May 20

Fertilizer: 60-60-60 (N-P₂O₅-K₂O) broadcasted and incorporated prior to planting; 75-0-0 (21%) on May 19

Plot Size: 4 x 25 ft

Treated: May 15 (PrF); June 15 (PoF)

Weed Size: None present

Crop Size: 4-5 leaf (some with 1 tiller) at PrF; 1 week prior to green ring at PoF

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi (PrF);
CO₂ backpack - 15 GPA, 110015, 32 psi (PoF)

Rated: May 28, July 2, Sept 10

Harvested: Aug 24

Experimental Design: Split plot (varieties as whole plots and herbicide treatments as subplots) 4 replications

Comments: Data presented in Table 25. Two applications of Stam were made to keep the area weed free. Rainfall was received 8 hours after the EP application and 5 hours after the LP application. Where herbicide treatments caused stunting and/or stand reduction, duck salad and redstem intrusion occurred. Furadan was applied on June 1 and Benlate was applied on June 13.

Table 25. Influence of Whip, Poast, and Verdict on rice phytotoxicity, heading, mature plant height, yield, and ratooning of Lemont, Gulfmont, Mars, and Mercury rice. Rice Research Station, Crowley, LA. 1987.^{1/}

Treatment	Rate of application (lb ai/A)	Application time ^{2/}	Phytotoxicity		Heading (%)	Plant ht. (in)	Yield (lb/A)	Ratoon rating ^{3/}
			5/28	7/2				
			----- (%) -----					
Check	--	--	0f ^{4/}	0h	99a	91a	7612a	8.8a
Whip	0.15	PrF	32d	9ef	94abcd	90a	7121bc	8.6ab
	0.30	PrF	54b	16c	88cd	89ab	6728cd	8.6ab
	0.15	PoF	0f	6fg	93abcd	82c	6763cd	8.4bc
	0.30	PoF	0f	8fg	95abc	77de	6446d	8.1cd
Poast	0.10	PrF	16e	4gh	96ab	89ab	7515ab	8.6ab
	0.20	PrF	40c	13cde	89bcd	87b	7200ab	8.5ab
	0.10	PoF	0f	11def	86de	82c	5898e	8.6ab
	0.20	PoF	1f	15cd	71f	79d	5331f	8.0d
Verdict	0.06	PrF	34d	11def	94abcd	90a	7408ab	8.6ab
	0.13	PrF	74a	33a	80e	88ab	5886e	7.9d
	0.06	PoF	0f	14cd	58g	77de	4777g	7.6e
	0.13	PoF	0f	22b	10h	75e	3686h	6.1f
CV (%)			38.0	48.6	12.3	4.2	9.0	5.7

^{1/} Data represent an average across rice varieties.

^{2/} PrF = preflood with rice at 4-5 leaf; PoF = postflood with rice 1 week prior to green wing.

^{3/} Ratings based on a scale of 0 = no regrowth and 10 = maximum regrowth.

^{4/} Means followed by the same letter within each column are not significantly different at the 5% level using Duncan's multiple range test.

Experiment: MON 7242 Test

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Lemont, 100 lb/A

Planting Date: Apr 8, 1987

Planting Method: Drilled 7 in

Flushed: Apr 14, Apr 20, Apr 24, and Apr 30

Permanent Flood: May 21

Fertilizer: 60-60-60 (N-P₂O₅-K₂O) banded at planting; 75-0-0 (21%) on May 19

Plot Size: 4 x 30 ft

Treated: Apr 20 (DP); May 8 (EP); May 17 (PrF)

Weed Size: None emerged at DP; BYG 2-3 leaf, PNS 3-4 inch, some AW present (running) at EP

Crop Size: None emerged at DP; 3 leaf at EP; 4 leaf at PrF

Sprayer: CO₂ backpack - 15 GPA, 110015 nozzles, 32 psi

Rated: June 25

Harvested: Aug 21

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 26. Rainfall of 0.1 in was received 2 hours after the EP application. Purple nutsedge was present throughout the area. On May 17 a new flush of grass was observed in the Stam treatments but not in the MON 7242 or Cinch treatments. Furadan was applied on June 1.

Table 26. Barnyardgrass (BYG), duckweed (DS), and purple nutsedge (PNS) control, and rice phytotoxicity and yield following several herbicide treatments. Rice Research Station, Crowley, LA. 1987..

Treatment	Rate of application (lb ai/A)	Application time	Weed control/ phytotoxicity 6/25				Yield (lb/A)
			BYG	DS	PNS	Rice	
			----- (%) -----				
Stam (4 EC)	3.0	EP	94	68	79	0	8263
Stam/Stam	3.0/3.0	EP/PrF	95	79	85	0	8545
Stam + MON 7242 (3 EC)	3.0/0.25	EP	95	95	53	5	7195
	3.0/0.50	EP	95	95	82	4	8351
	3.0/1.0	EP	95	95	72	18	7521
Stam + Cinch (7 EC)	3.0/0.13	EP	95	75	79	9	7551
	3.0/0.25	EP	95	81	81	6	7906
BAS 514 (50% WP)	0.25	DP	95	69	80	4	7518
	0.25	EP	95	74	50	9	7153
Check	--	--	0	56	0	4	6707
LSD (0.05)			1	15	35	7	997
CV (%)			0.9	12.7	36.0	83.0	9.0

Experiment: Garlon/Stam Rice Tolerance Test

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Lemont, 110 lb/A

Planting Date: Apr 14, 1987

Planting Method: Drilled 7 in

Flushed: Apr 20, Apr 30

Permanent Flood: May 22

Fertilizer: 60-60-60 (N-P₂O₅-K₂O) banded at planting; 100-0-0 (21%) on May 21

Plot Size: 4 x 25 ft

Treated: May 21 (PrF); June 15 (PoF); June 25 (PoFL)

Weed Size: None present

Crop Size: 4-5 leaf (some with tiller) at PrF; 1 week prior to panicle initiation or green ring at PoF; green ring at PoFL

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi (PrF);
CO₂ backpack - 15 GPA, 110015 nozzles, 32 psi (PoF and PoFL)

Rated: June 1

Harvested: Aug 28

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 27. The area was overtreated with BAS 514 at 0.25 lb/A on May 18. Excellent control was noted for palmleaf morningglory (6 to 8 inches and vining) and for barnyardgrass (some with 3 to 4 tillers).

Table 27. Tolerance of Lemont rice to Stam, Garlon, and Stam/Garlon tank mixes. Rice Research Station, Crowley, LA. 1987.

Treatment	Rate of application (lb ai/A)	Application time	Phytotoxicity 6/1 (%)	Yield (lb/A)
Garlon (3 EC)	0.25	PrF	16	5910
	0.38	PrF	24	5856
	0.50	PrF	26	5781
	0.25	PoF	0	6246
	0.38	PoF	0	6393
	0.50	PoF	0	6346
Stam (4 EC) + Garlon	2.0 + 0.25	PrF	20	6078
	2.0 + 0.25	PoF	0	6455
	2.0 + 0.38	PrF	23	5779
	2.0 + 0.38	PoF	0	6273
	3.0 + 0.25	PrF	19	6310
	3.0 + 0.25	PoF	0	6449
	3.0 + 0.38	PrF	25	5820
	3.0 + 0.38	PoF	0	6570
	3.0 + 0.50	PrF	31	5323
	3.0 + 0.50	PoF	0	6188
Garlon	0.50	PoFL ^{1/}	0	6108
Check	--	--	0	6662
LSD (0.05)			4	425
CV (%)			28.7	4.8

^{1/} Applied at panicle initiation (green ring).

Experiment: 2,4-D/Buctril Rice Tolerance Test

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Lemont, 110 lb/A

Planting Date: Apr 14, 1987

Planting Method: Drilled 7 in

Flushed: Apr 20, Apr 30

Permanent Flood: May 22

Fertilizer: 60-60-60 (N-P₂O₅-K₂O) banded at planting; 100-0-0 (21%) on May 21

Plot Size: 4 x 25 ft

Treated: May 21 (PrF); June 25 (PoFL)

Weed Size: None present

Crop Size: 4-5 leaf (some with 1 tiller) at PrF; panicle initiation or green ring at PoFL

Sprayer: Tractor compressed air - 20 GPA, 11003 nozzles, 25 psi;
CO₂ backpack - 15 GPA, 110015 nozzles, 32 psi (PoFL)

Rated: June 1

Harvested: Aug 28

Experimental Design: Randomized complete block, 4 replications

Comments: Data presented in Table 28. Two applications of Stam were made to keep the area weed free. Rainfall was received 8 hours after the EP application and 5 hours after the LP application. Where herbicide treatments caused stunting and/or stand reduction, duck salad and redstem intrusion occurred. Furadan was applied on June 1 and Benlate was applied on June 13. For the PrF treatments of 2,4-D at 0.50 lb/A or more, rice leaves were erect and rolled.

Table 28. Tolerance of Lemont rice to Stam/2,4-D and Stam/Buctril tank mixes.
Rice Research Station, Crowley, LA. 1987.

Treatment	Rate of application (lb ai/A)	Application time	Phytotoxicity 6/1 (%)	Yield (lb/A)
Stam (4 EC) + 2,4-D (4 EC)	3.0 + 0.06	PrF	3	6223
	3.0 + 0.13	PrF	8	6488
	3.0 + 0.25	PrF	10	5947
	3.0 + 0.50	PrF	14	5757
	3.0 + 1.00	PrF	30	4649
Stam + Buctril (2 EC)	2.0 + 0.25	PrF	6	6507
	3.0 + 0.25	PrF	5	6346
	3.0 + 0.38	PrF	2	6555
	3.0 + 0.50	PrF	8	6334
Stam/2,4-D	3.0/1.0	PrF/PoFL	0	6471
Check	--	--	0	6523
LSD (0.05)			6	475
CV (%)			55.5	5.3

CONCLUSIONS

Research in 1987 included evaluation of experimental and labeled herbicides, and prepackage mixes for control of weeds native to south Louisiana; determination of the impact of labeled herbicides on soybean injury and yield in weed free environment; and evaluation of liquid fertilizers and other adjuvants for potential enhancement of herbicide activity. Rainfall in 1987 was higher than normal with 4.7, 10.5, and 6.3 inches in May, June, and July, respectively. As a consequence, May-planted soybeans were exposed to extremely wet conditions early in the season. Unlike previous years, several flushes of weeds emerged and weed sizes varied considerably when postemergence treatments were made.

The performance of labeled herbicides was similar to that noted in previous years. Scepter and Canopy at labeled preemergence rates provided good to excellent control of annual grasses (not including red rice or itchgrass) pitted morningglory, cocklebur, and wild poinsettia. Scepter provided lower redweed and jointvetch control than that of Canopy. Command preemergence at 1.0 lb ai/A provided consistently good to excellent control of barnyardgrass and broadleaf signalgrass but red rice control was only fair to good. Scepter postemergence provided higher barnyardgrass, red rice, and mexicanweed control but lower control of morningglory, sicklepod, and jointvetch than that of Classic. In general, Pursuit (an experimental from American Cyanamid) was similar in activity to that of Scepter with the exception of slightly higher control of barnyardgrass and red rice than Scepter. Select (Chevron Chemical Co.) and BAS 517 (BASF Corp.) at 0.075 lb ai/A provided postemergence red rice control similar to that of Poast and Fusilade 2000. Cinch (DuPont) at 1.0 lb ai/A in tank mixtures with Canopy provided similar weed control when compared to Dual/Canopy and Lasso/Canopy.

The prepackage mixes evaluated included Turbo (Dual + Sencor), Salute (Treflan + Sencor), Squadron (Prowl + Scepter), Partner (Lasso + Scepter), and Storm (Basagran + Blazer). The benefit to using prepackage mixes include ease of handling and reduced cost compared to purchasing the component herbicides individually at the same proportions. When applied at the same rate, the prepackage mixes worked as well as the tank mixtures.

In the soybean tolerance studies, significant crop injury and mature plant height and yield reduction were noted for the double use rate of Canopy pre-emergence and for the labeled use rate of Canopy followed by both single and double use rate of Classic postemergence. The addition of liquid fertilizers 10-34-0 and 32-0-0 with both reduced and labeled rates of Scepter, Classic, Blazer, and Pursuit did not enhance herbicide activity when compared to nonionic surfactant. In some cases, addition of liquid fertilizer slightly reduced weed control. The addition of BAS 815 (Dash) with Poast and Storm did not increase weed control when compared to crop oil concentrate.

In rice, several herbicides were evaluated as alternatives to 2,4-D. BAS 514 showed promise for BYG control but appeared weak on sprangletop, aquatic weeds, sedges, and JV. Garlon and Butril appeared promising and may be applied earlier than 2,4-D without rice injury. Londax offers promise in water-seeded culture for broadleaf weed control. In studies evaluating application rates and timing of postemergence grass herbicides, Skybonnet and

Tebonnet were more tolerant to Whip applied preflood and postflood than Lemont, Gulfmont, Mars, or Mercury. With both Poast and Verdict, rice varieties were more tolerant to preflood than postflood application. Rice cultivars were more sensitive to double use rate of Verdict, either preflood or postflood, when compared to Whip or Poast. Of great concern is the fact that significant rice yield reduction occurred where only minimal early season visual injury was noted.

A successful weed control program in any crop is vital to obtaining maximum yields. In most cases, herbicides serve as the basic weed control measure. Use of sound agronomic practices in conjunction with herbicide use should encourage more rapid stand establishment thereby enhancing competition from the crop and reducing weed interference. Producers should be aware that it is both easier and less expensive to control weeds at early developmental stages. In addition, poor early season weed control may not be correctable later in the season. Since weeds are generally most competitive the first four weeks after planting, early weed control measures should minimize their adverse effect on crop yield.

ROTATIONAL CROPS RESEARCH

INTRODUCTION

Soybeans [Glycine max (L.) Merr.] are a major agronomic crop in Louisiana. Southwest Louisiana, where soybeans are grown primarily as a rotational crop with rice, is one of the major soybean producing areas in the state. Some of the soybean acreage is double cropped with wheat (Triticum aestivum L.). In recent years, grain sorghum [Sorghum bicolor (L.) Moench] acreage has increased. In the southwest area, grain sorghum may serve as an alternate crop to soybeans and may fit well into a rotation system with rice. Soybean, grain sorghum, and wheat varieties differ in their adaptability to soil types and climatic conditions. Consequently, variety trials are conducted at locations throughout the state to aid producers in selecting varieties best adapted to their area. Research is conducted at the Rice Research Station each year to compare performance of newly released and established soybean, grain sorghum, and wheat varieties and to determine the impact of integrating these alternate crops in rotation systems with rice.

SOYBEAN VARIETY TEST

J.L. Griffin, B.G. Harville, W. Hall, R.J. Habetz, and R.P. Regan

Location: Rice Research Station

Soil Type: Crowley silt loam

Seeding Rate: 10 seed/row ft

Planting Date: May 15, 1987

Row Spacing: 32 in

Fertilizer: 0-80-80 ($\text{N-P}_2\text{O}_5\text{-K}_2\text{O}$) banded at planting

Plot Size: 4 rows x 30 ft

Treated: 3.0 lb/A Lasso applied broadcast after planting

Rainfall: 1st week after planting - 0.26 in; 2nd week - 2.58 in; 3rd week - 0.25 in; 4th week - 1.62 in

Harvested: At maturity for each variety

Experimental Design: Randomized complete block, 4 replications

Comments: Yields were generally much higher than observed the previous year, and five varieties produced more than 50 bu/A (Table 1). The Group IV variety, Ring Around 451, yielded 53.2 bu/A in 1987 and over 3 years averaged 44.2 bu/A. The advantage to this variety is that it can be planted in April. Comparing 3-year average yields, only four varieties produced more than 35 bu/A; Ring Around 451, Terra Vig 505, Wilstar 550, and Deltapine 105. Three-year average yields of the Groups VI, VII, and VIII varieties were highest for Davis (26.6 bu/A), Pioneer 9791 (27.5 bu/A), and Hartz 8112 (18.1 bu/A), respectively.

Table 1. Performance of commercial soybean varieties grown on Crowley silt loam at Crowley, LA. 1987.

Maturity group and variety/brand	Yield per acre (bu)	3-year (1985-87) average yield (bu/A)	Date matured	Plant height at maturity (in)	Height of lower pod above ground (in)
<u>Group IV</u>					
Ring Around 452	33.7	----	9/29	38	4.5
Ring Around 451	53.2	44.2	9/17	38	4.5
C.V. %	8.5				
LSD (0.05) (bu)	6.4				
<u>Group V</u>					
Deltapine X415	52.9	----	9/21	23	3.5
Terra-Vig 505	51.0	37.0	9/25	27	4.0
Wilstar 550	49.8	36.7	9/30	21	3.5
Yield King 577	49.7	----	9/27	23	3.5
Deltapine 105	46.6	37.8	9/25	26	3.5
Bay	44.6	----	9/22	26	3.3
AgraTech 575	42.5	----	9/21	22	3.8
Coker 485	41.4	33.3	9/21	22	3.8
Hartz 5164	41.3	----	9/27	22	3.5
Pioneer 9581	39.1	34.4	9/21	21	3.5
Hartz 5370	37.0	32.9	9/21	21	3.5
AgraTech X550	36.5	----	9/30	25	3.3
Terra-Vig 553	36.4	30.9	9/22	24	3.8
M82-572403	36.0	----	9/17	18	2.5
Pioneer 9561	34.1	33.3	9/21	20	3.0
Asgrow 5980	33.0	31.2	9/20	28	4.0
Capehart Stone	31.9	----	9/20	19	2.8
Capehart/FFR 565	31.7	----	9/21	24	3.5
Hartz 5252	30.0	28.9	9/21	22	3.3
Hartz 5171	29.6	27.7	9/21	25	4.0
Deltapine 675	29.3	----	9/21	21	3.3
Capehart Exp. 5	29.0	----	9/21	19	2.5
Capehart/FFR 561	25.4	30.2	9/21	19	2.8
C.V. %	11.9				
LSD (0.05) (bu)	6.4				

Continued.

Table 1. (continued).

Maturity group and variety/brand	Yield per acre (bu)	3-year (1985-87) average yield (bu/A)	Date matured	Plant height at maturity (in)	Height of lower pod above ground (in)
<u>Group VI</u>					
Hartz X6372	55.5	----	10/13	21	3.3
Asgrow 6785	53.7	----	10/13	30	5.3
Davis	48.8	26.6	10/13	29	4.0
Ring Around 606	47.6	25.3	9/29	30	5.5
Hartz X6200	46.4	----	9/30	23	4.5
Yield King 699	45.1	----	10/2	29	4.0
S69-54	44.9	24.6	10/13	24	4.0
Terra-Vig 616	42.2	22.6	10/16	33	4.8
AgraTech 685	39.9	----	9/28	30	5.5
Spartan	39.1	22.2	10/16	37	5.0
B2J	37.4	----	9/30	21	4.0
Hartz X6344	35.4	----	10/8	23	3.5
Pioneer 9691	33.2	----	10/13	23	3.5
LeFlore	32.8	----	10/8	26	4.3
Ring Around 680	31.9	20.5	10/8	30	5.0
Baldwin	31.4	----	10/5	25	4.3
Yield King 613	30.1	18.4	9/25	31	4.0
Centennial	29.4	20.4	10/8	28	5.0
Hartz 6130	28.5	24.2	10/1	30	4.5
Hartz 6385	27.9	----	10/8	26	3.8
Coker 686	27.8	19.9	10/13	27	5.3
Deltapine 506	27.6	18.4	10/13	27	4.3
Sampson	27.6	18.6	10/10	24	4.0
Deltapine 566	26.2	18.1	10/13	22	3.0
Yield King 696	26.1	----	10/5	25	4.5
Deltapine X726	25.8	----	10/8	24	3.3
Sanalona	24.7	16.1	9/29	30	4.0
Hartz 6370	24.6	----	10/13	25	4.0
Asgrow 6242	23.9	16.7	9/25	20	2.8
Deltapine 986	20.6	----	9/23	30	4.5
Deltapine X1017	11.7	----	9/29	25	7.0
C.V. %	12.2				
LSD (0.05) (bu)	5.7				

Continued.

Table 1. (continued).

Maturity group and variety/brand	Yield per acre (bu)	3-year (1985-87) average yield (bu/A)	Date matured	Plant height at maturity (in)	Height of lower pod above ground (in)
<u>Group VII</u>					
M82-722611	48.6	----	10/10	24	3.5
Asgrow 7986	47.1	----	10/28	31	4.5
Funk 1409	46.3	----	10/20	28	5.3
Hartz 7126	45.1	26.8	10/22	29	4.3
Deltapine X2106	43.6	----	10/28	31	4.8
Ransom	42.1	26.6	10/23	27	5.5
Pioneer 9791	40.8	27.5	10/20	26	4.8
AgraTech 700	38.5	----	10/20	27	4.8
S72-60	36.7	24.0	10/15	28	4.0
Yield King 707	36.2	----	10/20	29	4.5
Deltapine 497	35.2	24.0	10/23	38	6.0
Coker 6727	30.5	----	10/13	23	3.3
Coker 6847	30.1	----	10/13	29	4.3
Starr	29.2	20.9	10/13	28	3.8
LA 79-11682	28.0	----	10/21	32	5.3
Wright	24.8	21.3	10/20	26	5.5
Gregg	21.8	----	10/13	28	4.3
Hartz 7110	17.9	----	10/28	27	5.3
C.V. %	8.4				
LSD (0.05) (bu)	4.3				
<u>Group VIII</u>					
Hartz 8112	30.1	18.1	10/28	27	5.3
Hartz X8300	21.5	----	10/20	27	4.5
Coker 6738	20.1	----	10/20	33	6.0
Coker 488	19.3	----	10/20	35	5.3
Coker 368	18.1	14.0	10/20	31	4.8
C.V. %	12.1				
LSD (0.05) (bu)	4.0				

GRAIN SORGHUM VARIETY TEST

J.L. Griffin, D.E. Groth, M.S. Kang, W. Hall, R.J. Habetz, and R.P. Regan

Location: Rice Research Station

Soil Type: Crowley silt loam

Planting Date: May 12, 1987

Row Spacing: 32 in

Fertilizer: 40-80-80 ($\text{N-P}_2\text{O}_5\text{-K}_2\text{O}$) banded at planting; 80-0-0 (21%) on June 1

Plot Size: 4 rows x 30 ft

Treated: 1.5 lb/A atrazine applied broadcast after planting

Rainfall: 1st week after planting - 1.04 in; 2nd week - 1.92 in; 3rd week - 0.90 in; 4th week, 0.34 in

Harvested: Sept 3

Experimental Design: Randomized complete block, 4 replications

Comments: The grain sorghum variety trial has been conducted only three years. In 1987, 26 early and late maturity varieties were evaluated. For the early varieties in 1987, only two entries, Cargill 1022 and G-522DR, produced more than 4000 lb/A (Table 1). Three-year average yields with the exception of HT 126DR and 8300 were less than 3800 lb/A, partly reflecting the reduced yields observed in 1986. For the late varieties in 1987, Seedtec/WAC D701G, NK 2665, Coker 7675, Topaz, Cargill 5572, and DK-50 produced more than 4000 lb/A (Table 2). Three-year average yields were more than 4000 lb/A for Coker 7675 and Topaz.

Table 1. Performance of early maturity, bird-susceptible grain sorghum hybrids at Crowley, LA. 1987.

Company/Brand	Hybrid	Yield			Grain moisture (%)	Head blight rating ^{1/}	Sheath blight rating ^{1/}
		1987	2-year average	3-year average			
		-----lb/A-----					
Cargill, Inc.	Cargill 1022	4199	3120	3640	13.3	2.0	4.0
Funk Seeds Int.	G-522 DR	4063	3388	3717	12.9	3.3	3.5
George Warner	W-844	3905	-----	-----	13.3	1.3	3.8
Capehart Seed	Capehart Contender	3899	-----	-----	12.6	4.0	3.8
Asgrow Seed	GS 712	3821	3428	3760	12.9	2.5	3.0
Terral-Norris	Sunbelt 444	3773	3042	3570	12.6	3.5	3.8
Seedtec Int.	Seedtec/WAC 710DR	3744	-----	-----	12.7	3.3	3.5
Summit Seed	HT 126DR	3737	3508	3817	13.2	3.5	3.5
Stauffer	New N. King S9750	3715	3242	3601	12.9	2.3	3.0
Hyperformer	1225 DR	3703	3480	3670	12.9	4.3	3.8
Hyperformer	HSC Cherokee	3606	-----	-----	13.8	1.3	3.8
Pioneer Hi-Bred Int.	8300	3588	3437	3815	12.7	4.3	3.8
Alexandria Seed	Alex 2200	3449	2935	-----	12.9	3.5	3.8
Seedtec Int.	Seedtec/WAC 686	3448	2906	-----	13.7	1.3	3.5
Alexandria Seed	Alex 2000	3401	3378	-----	12.6	3.3	3.8
George Warner	W-839 DR	3372	3187	3477	12.9	3.5	3.8
Alexandria Seed	Alex 2210	3297	3132	-----	13.2	1.0	3.3
Pioneer Hi-Bred Int.	8333	3219	3135	3578	12.8	3.5	3.5
Capehart Seed	Capehart Charger	3098	-----	-----	13.0	2.0	3.5
Funk Seeds Int.	G-1602	3090	2422	2911	12.6	2.0	4.0
Pioneer Hi-Bred Int.	8226	2867	2640	-----	13.2	2.0	4.5
Funk Seeds Int.	HW-7380	2824	-----	-----	12.8	2.5	3.5
Pioneer Hi-Bred Int.	8222	2665	2736	3389	13.0	3.8	5.0
Cargill, Inc.	Cargill 4462	2625	2467	3177	12.8	3.5	3.3
Cargill, Inc.	Cargill R1090	2362	2172	2988	12.1	5.3	3.8
Cargill, Inc.	Cargill 70	2340	-----	-----	12.5	4.5	4.8
Mean		3377			12.9	2.95	3.72
C.V. %		17.6			3.2	24.9	22.3
LSD (.05)		840			0.57	1.03	1.17

^{1/} 1-5 scale, 1 = low infection, 5 = maximum infection.

Table 2. Performance of late maturity, bird-susceptible grain sorghum hybrids at Crowley, LA. 1987.

Company/Brand	Hybrid	Yield		Grain moisture (%)	Head blight rating ^{1/}	Sheath blight rating ^{1/}
		1987	2-year average -----lb/A-----			
Seedtec Int.	Seedtec/WAC D701G	4217	3767	3910	1.75	3.50
Northrup King	NK 2665	4213	3493	3828	2.50	3.75
Coker Pedigreed Seed	Coker 7675	4200	3949	4010	2.75	4.25
Asgrow Seed	Topaz	4166	3918	4082	2.50	3.25
Cargill, Inc.	Cargill 5572	4163	-----	-----	3.00	4.00
DeKalb-Pfizer	DK-50	4124	3671	-----	1.00	4.50
Coker Pedigreed Seed	Coker 7737	3992	3277	-----	1.50	3.25
Cargill, Inc.	Cargill DR 1125	3972	3337	3687	3.00	3.75
Funk Seeds Int.	G-1711	3965	3601	3950	2.50	3.25
Funk Seeds Int.	RA 808	3948	3416	-----	3.75	3.75
George Warner	W-851 DR	3923	3025	3205	3.25	4.00
Funk Seeds Int.	HW 6624	3893	-----	-----	1.75	3.50
Cargill, Inc.	Cargill 6670	3872	3420	3882	1.75	3.00
Cargill, Inc.	Cargill 1096y	3848	3443	-----	1.00	4.25
Taylor-Evans	T-E Dinero	3844	3220	3729	3.75	4.00
DeKalb-Pfizer	DK-64	3766	3437	3741	2.50	4.75
Capehart Seed	Cape. Challenger	3762	-----	-----	2.00	4.00
Hyperformer	HSC Wings	3683	-----	-----	2.00	2.75
Funk Seeds Int.	RA787	3674	3337	-----	2.50	4.25
Hyperformer	1330 DR	3670	3486	3736	1.75	3.75
Northrup King	NK 2887	3655	-----	-----	2.00	3.25
Asgrow Seed	Osage	3646	-----	-----	1.75	4.25
Taylor-Evans	T-E y-75	3516	2843	3328	1.75	4.00
DeKalb-Pfizer	M-565	3494	3075	3553	3.00	4.00
Capehart Seed	Cape. Champion	3393	-----	-----	2.50	3.00
Northrup King	NK 2660	2895	2999	3371	3.25	4.00
Mean		3827			2.34	3.77
C.V. %		17.7			32.7	19.7
LSD (.05)		954			1.08	1.05

^{1/} 1-5 scale, 1 = low infection, 5 = maximum infection.

WHEAT VARIETY TEST

J.L. Griffin, S.A. Harrison, R.J. Habetz, and R.P. Regan

Location: Rice Research Station

Soil Type: Crowley silt loam

Seeding Rate: 90 lb/A

Planting Date: Nov 18, 1986

Fertilizer: 30-90-90 (N-P₂O₅-K₂O) broadcast and incorporated prior to planting; 80-0-0 (21%) on Feb 18

Plot Size: 4 x 40 ft

Harvested: May 22

Experimental Design: Randomized complete block, 4 replications

Comments: The average yield of all varieties for 1987 was 49.3 bu/A (Table 1). Florida 302 had the highest yield (67.4 bu/A), followed by Coker 916, two experimental lines, and a new variety, Coker 9766. The earlier varieties were damaged by cold in early April. The average test weight of the entries was 54.7 lb/bushel, with a high of 57.0 lb/bushel. Leaf rust, stripe rust, and stem rust were all significant problems, averaging 11, 7, and 15%, respectively. Stripe rust was quite severe on some varieties and probably had a significant effect on yield. It is too early to determine if stripe rust will become a major problem in Louisiana. It is more likely that the unusual weather patterns of last winter were particularly conducive to stripe rust development. Leaf rust was moderately severe on susceptible varieties, especially McNair 1003 and Rosen. Stem rust developed late in the growing season and probably did not have a significant effect on yields. There was a significant negative correlation between bacteria rating and yield ($r = -0.41^*$). Coker 9733 appeared to be particularly susceptible to the disease. Florida 302 had a 3-year mean yield of 72.7 bu/A (Table 2). The average 3-year mean yield of 12 varieties was 53.7 bu/A. In addition to Florida 302, Coker 916, Coker 983, McNair 1003, Rosen, and Terral 812 are recommended for the prairie soils of southwest Louisiana. Several recommended varieties appear to be particularly susceptible to disease pressure. Growers who choose susceptible varieties should monitor their crops on a regular basis and be prepared to spray a fungicide if disease pressure builds up.

Table 1. Performance of entries in the wheat performance trials at the Rice Research Station, Crowley, LA. 1987.

Variety	Yield ^{1/} (bu/A)	Test weight ^{1/} (lb/bu)	Head day ^{2/}	Leaf rust	Stem rust	Stripe rust	Bacteria ^{3/} (score)
				------(%)-----			
Florida 302	67.4	53.9	94	5	1	4	4.5
Coker 916	60.4	54.1	98	8	12	8	4.5
Coker 85-42	56.8	55.0	96	5	10	32	6.5
Coker 85-43	55.9	53.9	93	8	10	40	5.0
Coker 9766	55.7	53.9	94	2	8	5	6.0
Coker 747	55.2	53.3	102	4	2	8	4.5
McNair 1003	54.7	55.0	93	25	11	1	6.0
Pioneer 2551	54.6	54.0	104	12	2	1	3.5
Coker 983	53.2	56.0	88	8	18	30	5.5
Terral 812	52.8	53.4	87	2	8	6	5.5
Coker 762	51.2	49.4	89	18	4	22	5.5
Rosen	50.9	54.9	95	75	18	12	5.5
Williams	50.7	55.1	102	10	10	4	5.0
EH 8504	50.2	56.0	90	10	12	15	6.0
Twain	48.3	55.1	102	5	2	1	4.0
AR 48-7-4	48.2	54.7	95	20	5	1	5.5
Coker 93-23	47.7	56.7	88	12	8	63	6.5
Terral 817	44.4	54.8	87	5	8	28	4.5
Coker 92-27	41.0	57.0	84	2	5	0	7.5
Hunter	40.4	56.4	82	15	5	33	6.0
Coker 9733	32.2	54.3	87	0	0	8	8.5
Florida 301	31.3	55.2	84	0	1	4	4.5
Coker 797	30.1	55.3	77	1	8	13	6.0
Mean	49.3	54.7	92	11	7	15	5.5
C.V. %	10.3	5.2		63	80	88	19
LSD (0.05)	7.2	4.1		14	12	21	2.2

^{1/} Adjusted to 13% moisture. Yield differences of less than 7.2 bushels are not significant at the 0.05 probability level.

^{2/} Days after January 1.

^{3/} Rated on a scale of 1-9; 1 = no disease, 9 = very severe.
Probably Pseudomonas.

Table 2. Performance of entries in the wheat performance trials at the Rice Research Station, Crowley, LA, for three years, 1985-87.

Variety	Yield ^{1/}				Test ^{1/} weight (lb/bu)	Head ^{2/} day	Leaf rust (%)	Stem rust (%)	Bact ^{3/} (score)
	1985	1986	1987	Mean					
	----- (bu/A) -----								
Florida 302	80.0	70.8	67.4	72.7	56.3	94	7	2	6.3
Terral 812	77.9	56.5	52.8	62.4	55.6	87	6	39	7.5
Coker 916	73.9	52.2	60.4	62.2	55.9	96	12	54	6.0
Coker 983	72.2	58.3	53.2	61.2	57.9	89	10	30	7.2
McNair 1003	76.0	48.0	54.7	59.6	55.4	93	27	26	8.0
Rosen	72.3	53.6	50.9	58.9	55.8	92	60	40	7.8
Hunter	72.5	57.8	40.4	56.9	58.3	84	17	28	7.5
Terral 817	79.9	45.3	44.4	56.6	57.0	88	8	10	7.2
Coker 762	66.5	48.4	51.2	55.4	53.6	92	17	39	7.8
Coker 747	63.6	43.6	55.2	54.1	55.6	100	4	27	7.5
Coker 797	82.6	47.1	30.1	53.3	57.2	81	3	34	8.0
Florida 301	71.8	38.6	31.3	47.2	56.6	84	5	3	7.0
Mean	74.1	51.7	49.3	58.4	56.3	90	15	28	7.3
C.V. %				11.5	4.6		59	56	16
LSD (0.05)				12.5	2.8		23	42	1.0
Coker 93-23	----	59.8	56.7	53.7	57.4	84	12	41	7.2
Pioneer 2551	----	49.1	54.6	51.9	54.7	102	10	4	7.2
Coker 92-27	----	42.4	41.0	41.7	58.2	83	6	52	5.7
Mean ^{4/}				50.2	56.4	90	14	28	7.2

^{1/} Adjusted to 13% moisture. Three-year average yield differences of less than 5.4 bushels per acre are not significantly different at the 0.05 probability level. Test weight, leaf rust, and stem rust are averages of 1986 and 1987 data.

^{2/} Days after January 1.

^{3/} Rated on a scale of 1-9; 1 = no disease, 9 = severe. 1986 and 1987 data. Probably *Psuedomonas*.

^{4/} Mean of all entries tested for the past two years, including those in the three-year mean.

WHEAT FERTILIZATION/FUNGICIDE TEST

J.L. Griffin, D.E. Groth, R.J. Habetz, and R.P. Regan

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Coker 762 and Florida 302, 90 lb/A

Planting Date: Nov 18, 1986

Row Spacing: 7 in

Fertilizer: 25-100-100 banded at planting; 38, 50, 63, 75, 100, 125 lb N/A as ammonium sulfate applied on Feb 10, 1987 (growth stage 4, Feekes' scale) and/or Mar 3 (growth stage 6)

Plot Size: 4 x 25 ft

Harvested: May 22

Experimental Design: Randomized complete block design, 4 replications

Comments: This study was conducted to determine the effect of nitrogen timing and rate and fungicide application on yield and disease incidence in wheat. At planting, 25 lb N/A was applied across all treatments. Nitrogen was topdressed at growth stage 4 (when leaf sheaths lengthened) on Feb 10, at growth stage 6 (when first node on stem was visible) on Mar 3, or at growth stage 4 and 6 (one half of N at each stage). In addition, Dithane was applied once at 2 lb/A on Mar 20 at stage 10 (boot stage). Maximum wheat yields for both varieties were obtained where N was topdressed at 75 lb/A (Table 1). Wheat yields were higher for both varieties when N was applied at 75 lb/A at stage 4 than at stage 6. Yield for the split application of 38 lb N/A at stage 4 and 6 were comparable to the single application of 75 lb N/A at stage 4. Application of Dithane following 75 lb N/A at stage 4 increased yields 10.6 and 6.3 bu/A, respectively, for Coker 762 and Florida 302. Test weight was not greatly affected by the nitrogen or fungicide treatments.

Table 1. Response of Coker 762 and Florida 302 wheat to N rate and timing and fungicide application. Rice Research Station, Crowley, LA. 1986-1987.

N timing and rate ^{1/}		Yield (bu/A)		Test wt (lb/bu)	
Feekes' 4	Feekes' 6	With Fungicide ^{2/}	Without Fungicide	With Fungicide ^{2/}	Without Fungicide
-----Coker 762-----					
0	75	45.9	43.5	52.9	53.1
75	0	66.2	55.6	53.4	54.1
38	38	59.0	54.3	53.5	53.6
0	100	47.4	45.2	52.8	53.3
50	50	62.5	54.1	54.7	53.4
0	125	43.2	36.8	52.7	52.3
63	63	62.7	54.8	53.8	53.4
C.V. %			9.5	1.5	
LSD (0.05)			7.1	1.2	
-----Florida 302-----					
0	75	67.5	64.7	54.0	53.3
75	0	77.6	71.3	54.1	54.1
38	38	74.1	65.7	54.1	54.1
0	100	68.0	65.1	53.5	53.7
50	50	78.7	72.9	54.2	53.4
0	125	65.5	63.0	54.1	53.5
63	63	78.2	75.6	53.7	53.5
C.V. %			8.0	0.8	
LSD (0.05)			8.1	0.6	

^{1/} All treatments followed 25 lb N/A applied at planting.

^{2/} Dithane fungicide at 2 lb/A applied at boot stage.

INFLUENCE OF CROPPING SYSTEMS ON LONG-TERM SOYBEAN PRODUCTION

J.L. Griffin, R.J. Habetz, and R.P. Regan

Location: Rice Research Station

Soil Type: Crowley silt loam

Variety/Seeding Rate: Centennial, 50 lb/A

Planting Date: May 20, 1987

Row Spacing: 30 in

Fertilizer: 0-60-60 broadcast and incorporated prior to planting

Plot Size: 0.2 acre

Treated: 2.0 lb/A Dual + 0.25 lb/A Lexone

Harvested: Oct 14

Experimental Design: Randomized complete block, 3 replications

Comments: This study was initiated in 1982 to compare changes in crop yield, soil fertility, and insect, disease, and weed pressure associated with five cropping systems: 1) continuous soybeans; 2) continuous soybeans double cropped with wheat; 3) continuous soybeans with vetch as a winter crop; 4) a 1-year grain sorghum/2-year soybean rotation; and 5) a 1-year fallow/2-year soybean rotation. The cropping sequences for each year are shown in Table 1. Initial soil fertility levels for the experimental area in 1982 were pH = 5.8, organic matter = 1.08%, phosphorus = 45 ppm, and potassium = 102 ppm. Soil samples taken in 1985 indicated that soil organic matter levels had increased for all cropping systems since initiation of the study. Organic matter tended to be highest for the soybean-wheat, soybean-vetch, and grain sorghum-soybean systems, averaging 1.8%. Soybean yields over 5 years were similar for continuous soybean, soybean-vetch, grain sorghum-soybean, and fallow-soybean cropping systems ranging from approximately 40 bu/A in 1982 and 1983 to approximately 20 bu/A in 1984, 1985, and 1986 (Table 2). The lower yields in 1984 and 1985 were due in part to inclement weather around harvest time. In 1986, extremely dry conditions occurred in combination with "green bean" problems. Soybean yields over 4 years averaged 2.5 bu/A lower where soybeans followed wheat as compared with continuous soybeans. Wheat yields have been as high as 63 bu/A and grain sorghum as high as 5818 lb/A, indicating their potential for the southwest Louisiana area.

Disease and insect pressure have been similar regardless of the cropping system. Weed pressure, especially from mexican weed [*Caperonia castaniifolia* (L.) St. Hil.], and drought stress were more severe in soybeans following wheat as compared with the other cropping systems.

Table 1. Cropping systems evaluated at the Rice Research Station, Crowley, LA. 1982-1987.

Cropping system	1982	1983	1984	1985	1986	1987
1	S	S	S	S	S	S
2	S-W	S-W	S-W	S-W	S-W	S-W
3	S-V	S-V	S-V	S-V	S-V	S-V
4	GS	S	S	GS	S	S
5	F	S	S	F	S	S

S = soybeans, GS = grain sorghum, W = wheat, V = vetch, F = fallow.

Table 2. Crop yields for the soybean cropping systems study. Rice Research Station, Crowley, LA. 1982-1986.

Cropping systems	Yield (bu/A)								
	Fall 1982	Spring 1983	Fall 1983	Spring 1984	Fall 1984	Spring 1985	Fall 1985	Fall 1986	Fall 1987
Continuous soybeans	42.2	--	42.1	--	20.6	--	19.4	18.6	30.1
Soybeans/wheat	39.4	35.0	40.0	63.0	20.8	53.7	14.3	21.9	32.4
Soybeans/vetch	43.1	--	43.1	--	20.1	--	17.7	20.9	31.6
Grain sorghum - soybeans	3648 lb/A	--	45.1	--	19.6	--	5818 lb/A	22.3	32.2
Fallow plow - soybeans	--	--	46.3	--	20.4	--	--	22.3	30.5
LSD (0.05)	NS	--	3.1	--	NS	--	NS	NS	NS

AQUACULTURE RESEARCH

EVALUATION OF RICE CULTIVARS FOR DOUBLE CROPPING WITH CRAWFISH

M.W. Brunson, B.J. Hoff, D.K. Riecke, and S.M. Simon

Twenty-five domestic rice (*Oryza sativa* L.) cultivars were evaluated in a simulated rice/crawfish double cropping system in southwest Louisiana. Wide variation was observed among cultivars in parameters believed to be important for maximizing productivity in such a system. Mean maturity ranged from 99 ('Labelle') to 118 days ('Starbonnet'), while height ranged from 30 ('Bellemont') to 51 inches ('Della,' 'Nato'). Significant differences in grain yield response were observed, with yields ranging from 3656 ('Bluebelle') to 5941 lb/A ('Newbonnet'). Straw dry matter production varied greatly, from 3415 (Bellemont) to 8174 lb/A (Della), and was positively correlated with plant height ($r=0.64$; $P=0.0001$). Ratoon biomass production was negatively correlated with both grain yield ($r=-0.39$; $P=0.0001$) and maturity group ($r=-0.69$; $P=0.0001$). Plant senescence at grain maturity also varied greatly and appears to be a factor in post-harvest ratoon capability. Early or very early maturing cultivars with both proven grain production and good ratooning capability appear best suited. Cultivar selection should be based upon individual farm situations and currently employed agronomic practices.

Table 1. Two-year biomass yield components of 25 domestic rice cultivars in a simulated rice/crawfish double cropping system in 1983-84 at the Rice Research Station, Crowley, LA.

Cultivar	Grain yield ^{1/}	Straw dry matter	Combined grain and straw dry matter	Ratoon dry matter (rating ^{2/})
Bluebelle	3656	4874	8090	314 (2.9)
Bellemont	3687	3415	6660	1047 (9.0)
Bonnet 73	4995	7289	11682	262 (2.5)
Bond	5321	5553	10231	436 (5.1)
Brazos	5101	5938	10431	821 (7.8)
Dawn	3820	3588	11406	586 (5.9)
Della	4143	8174	11331	647 (5.1)
Labelle	4564	4736	8752	1084 (7.8)
Lebonnet	4743	4960	9133	316 (5.2)
Leah	4209	5995	9699	858 (8.5)
Lemont	5213	5380	9967	455 (5.5)
L-201	5034	4871	9300	1382 (8.8)
Mars	5216	7276	11866	808 (7.5)
M-9	4597	4723	8767	1265 (9.0)
Nato	4273	5704	9468	372 (4.8)
Nortai	5345	7525	12473	488 (6.9)
Nova 66	4798	7686	11909	622 (5.5)
Nova 76	5520	7436	12317	403 (4.3)
Newbonnet	5941	6853	12081	197 (1.6)
Newrex	4953	6087	10442	813 (7.4)
Pecos	4994	6029	10423	1294 (9.0)
Skybonnet	4466	5530	9460	962 (8.7)
Starbonnet	5253	7320	11942	194 (2.0)
Saturn	5375	6099	10828	206 (2.8)
Vista	4953	6844	11203	894 (7.5)
$\bar{x}$	4806	6174	10404	666
1sd (0.05)	579	737	1202	201
C.V. %	13.4	13.3	10.9	33.6

^{1/} All yields expressed in lb/A; grain yields adjusted to 12% moisture.

^{2/} Ratings based on scale 0-9 where 0 = no mature culms producing ratoon tillers, 1 = 1-10%, 2 = 11-20%...9 = > 1% of mature culms producing ratoon tillers.

Table 2. Two-year average planting to grain maturity parameters for 25 domestic rice cultivars in a simulated rice/crawfish double cropping system in 1983-84 at the Rice Research Station, Crowley, LA.

Cultivar	Days to maturity ^{1/}	Height (in) at grain maturity	Lodging at grain maturity ^{2/}	Senescence at grain maturity ^{3/}
Bluebelle	108	43	0.8	6.0
Bellemont	110	30	0.0	3.0
Bonnet 73	115	47	0.3	2.3
Bond	100	39	0.1	2.0
Brazos	103	42	3.6	1.3
Dawn	112	50	0.1	6.3
Della	111	51	2.9	3.5
Labelle	119	43	2.3	2.0
Lebonnet	110	44	0.3	3.8
Leah	107	37	0.0	1.8
Lemont	110	34	0.0	5.3
L-201	106	41	1.6	1.0
Mars	106	42	2.5	1.8
M-9	106	37	4.3	1.0
Nato	111	51	3.3	2.5
Nortai	110	43	2.0	1.0
Nova 66	108	49	3.1	2.3
Nova 76	110	45	0.4	1.3
Newbonnet	112	41	0.1	7.5
Newrex	105	41	0.4	1.8
Pecos	102	39	5.6	1.3
Skybonnet	104	42	0.6	1.8
Starbonnet	118	46	0.0	3.3
Saturn	108	50	4.8	8.5
Vista	103	46	4.6	2.5
$\bar{x}$	107	43	1.8	3.0
lsd (0.05)	0.8	2	1.4	1.8
C.V. (%)	1.1	3.8	7.8	17.6

^{1/} Maturity = days to 50% head plus 30.

^{2/} Subjective rating 0-9: 0 = no lodging, 1 = 1-10%, 2 = 11-20% . . . 9 = 81% or more lodged.

^{3/} Subjective rating: 0 = no stem or leaf senescence, 1 = 1-10%, 2 = 11-20% . . . 9 = >81% stem and leaf tissue senescent.

CRAWFISH AND RICE PRODUCTION IN DOUBLE CROPPED PONDS

M.W. Brunson, D.K. Riecke, and S.M. Simon

Louisiana has over 140,000 acres of commercial crawfish (Procambarus spp.) ponds, and the integrated culture of rice and crawfish is well documented and firmly entrenched in the south Louisiana agricultural enterprise. Although crawfish have been harvested as an incidental crop from rice fields for many years, semi-intensive rice-field culture of crawfish has only recently been established. Preliminary studies have been aimed at evaluation of rice cultivars for desirable attributes in a rice/crawfish double cropping system. Rice breeding programs across the United States operate with the general objective of developing rice cultivars that produce high field yields and still meet both producer and consumer demands. Cultivar development efforts, however, have concentrated primarily on improvement of food rice production characteristics with little or no concern for parameters which might be important in rice polyculture systems. We previously evaluated 25 rice cultivars and found great variation in several parameters believed to be important for double cropping with crawfish. This study was conducted to determine the significance of those parameters and to evaluate the impacts of rice cultivar selection upon production of grain and crawfish in a rice/crawfish double cropping system.

MATERIALS AND METHODS

Six rice cultivars were selected from the 25 previously evaluated representing a wide range of characteristics and plant types. These include 'Labelle,' 'Mars,' 'Saturn,' 'Lemont,' 'Starbonnet,' and 'Nortai.' Rice was drill seeded into a prepared seedbed (7 in row spacings) at the rate of 90 lb/A on 30 May 1985 and dry broadcast seeded into a rough seedbed at the rate of 120 lb/A on 26 June 1986. Experimental ponds were 0.2 acre, separated by rice field type levees 6 ft in width. Fertilizer at the rate of 60-60-60 lb/A ($\text{N-P}_{25}\text{-K}_{20}$) was incorporated prior to planting. In both years, rice was flushed immediately after planting to encourage germination. Propanil (3',4'-dichloropropionanilde[N-(3,4-dichlorophenyl)propionanide]) was applied at the rate of 4 lb ai/A for weed control when grasses were at the 2-4 leaf stage. A fertilizer topdressing of 40-0-0 was applied on 1 July 1985 and 23 July 1986. A shallow (4 in) permanent flood was established on 2 July 1985 and 24 July 1986 and maintained until grain maturity.

At grain maturity, an area of 25 ft² was hand harvested leaving 1-2 in stubble in order to determine straw and total biomass yield. Grain was combine harvested from a 500 ft² area and yields were adjusted to 12% moisture. After grain sampling, all plots were completely harvested to remove grain, leaving as much stubble height as possible. Stubble was flushed after grain harvest to encourage ratoon development and a permanent fall flood (15 in) was established on 1 November both years. Prior to flood-up and at subsequent 6-wk intervals, plots were sampled by removing all vegetation within a 25 ft² area. Stubble, ratoon, and grain components were separated and quantified. All vegetative

samples were dried in a forced air drier at 150°F until a constant weight was attained and dry matter biomass was determined.

Stand ratings based on an arbitrary scale of 1-10 (10 = ideal stand) were taken 2 and 5 wk postemergence. Heading date (50% head emergence) was recorded for each cultivar, and maturity was arbitrarily calculated as heading date plus 30 days. Plant height was recorded and lodging at harvest was rated on the scale 0-9 where 0 = no mature culms producing ratoon tillers, 1 = 1-10%, 2 = 11-20%...9 = >81% of mature culms producing ratoon tillers. Plant senescence (0-9; 0 = no stem or leaf senescence, 1 = 1-10%, 2 = 11-20%...9 = >81% stem or leaf senescence) was rated at grain harvest, at flood-up, and 6-wk post-flood.

Experimental design was a randomized complete block with four replications. Data were subjected to statistical analyses using the GLM module of SAS for personal computers (SAS Institute 1985) and mean separation was accomplished by Fisher's protected least significant difference (LSD). All tests of significance were conducted at the 0.05 probability level.

Table 1. Two-year means for planting to grain maturation parameters for six rice varieties utilized in double cropped crawfish ponds at the Rice Research Station, Crowley, LA. 1985-87.

Var	Days to 50% heading	Height (in)	Lodging ^{1/}
Labelle	72c	42c	1.25c
Nortai	79c	40d	1.0c
Mars	77d	40d	1.0c
Saturn	80b	48a	8.0a
Lemont	79c	33e	1.0c
Starbonnet	87a	45b	2.3b
CV			
lsd (.05)	0.63	0.94	0.47

^{1/} Subjective rating: 1 = 1-10% lodged, 2 = 11-20%, 3 = 21-30% . . .
9 = >81% lodged.

Table 2. Biomass production at grain harvest and crawfish pond flood-up for six rice varieties utilized in double cropped crawfish ponds at the Rice Research Station, Crowley, LA. 1985-86.

Var	Grain (12% H ₂ O)	Straw ^{1/}	Total biomass at flood	Ratoon biomass at flood		
				Year 1	Year 2	Mean
Labelle	3826d	3289c	2020b,c	708	868	788a,b
Nortai	4161c,d	4265a,b	2691c	768	1191	979a
Mars	5130a	4841a,b	2391a,b	417	847	632b
Saturn	4538b,c	4204b	1023d	104	116	110c
Lemont	4778a,b	4839a,b	1997b,c	197	252	225c
Starbonnet	4671b	5117a	2575a	171	179	175c
CV						
1sd (.05)	424	866	455			215

^{1/} All yields except grain expressed in lb dry matter/acre.

Table 3. Post-flood biomass persistence of six rice varieties utilized in double cropped crawfish ponds at the Rice Research Station, Crowley, LA. 1985-87.

Var	Total biomass			Ratoon biomass			Biomass	Biomass
	6 wks			6 wks post-flood			12 WPF	18 WPF
	post-flood ^{1/}						Mean	Mean
	Year 1	Year 2	Mean	Year 1	Year 2	Mean		
Labelle	3318	4233	3776a	2704	3083	2894a	1026b,c	538c
Nortai	2985	3902	3444a,b	1852	2363	2107b	1767a	1370a
Mars	2561	3451	3006b	1693	2020	1857b	1226b	770b
Saturn	498	872	685d	381	518	449c	553d	283d
Lemont	1815	1431	1623c	465	901	683c	1076b,c	577c
Starbonnet	2310	2063	2187c	309	295	302c	809c,d	382d
CV								
1sd (.05)			693			427	279	129

^{1/} All yields expressed in lb dry matter/acre.

Table 4. Crawfish production (lb/A) in rice/crawfish ponds planted to six rice cultivars at the Rice Research Station, Crowley, LA. 1985-87.

Variety	1985-86	1986-87	Mean
Labelle	1971a	1670a	1820a
Nortai	2005a	1863a	1934a
Mars	1798a	1627a	1712a
Saturn	1451b	1389b	1420b
Lemont	1945a	1660a	1802a
Starbonnet	1841a	1577a	1709a

a,b/ Means within any column not followed by the same letter are significantly (P<0.05) different according to Fisher's protected LSD.

PRELIMINARY EVALUATIONS OF DUPONT LONG-LIFE CRAWFISH BAIT

M.W. Brunson, D.K. Riecke, and S.M. Simon

Experimental formulations of Dupont long-life crawfish bait from the Dupont Laboratory at Orange, Texas were compared to the Dupont commercial formulation and to cut fish in baited traps March through May. Traps were baited with fresh fish daily, but the Dupont formulations were allowed to remain in traps until disappearance (3-7 days). Although formulation identities and descriptions are proprietary, some general observations can be made.

Catch per unit effort most highly correlated with water temperature, and at temperatures below 60°F cut fish was the superior bait. Wide variation was observed among the experimental Dupont formulations both in water stability (range 1-7 days) and in crawfish attractability.

Catch data have been provided to Dupont and are being used to develop improved formulations in their commercial bait. Dupont provided the baits and monetary support for this project.

EVALUATION OF THREE SORGHUMS AS POTENTIAL FORAGE CROPS FOR CRAWFISH

M.W. Brunson, D.K. Riecke, and S.M. Simon

Three cultivars of *Sorghum bicolor* (L.) Moench (grain sorghum, forage sorghum, and a sorghum sudangrass hybrid) were evaluated as planted forages for crawfish (*Procambarus* spp.) in two simulated culture systems, double cropping and crawfish monoculture. Based upon ease of culture, biomass production, and biomass degradation characteristics, grain sorghum and sorghum sudangrass exhibited great potential for either system. With the added advantage of grain production, grain sorghum represents the more attractive option and may provide farmers with a viable alternative to rice for double cropping with crawfish. The sorghum sudangrass produced large amounts of vegetative biomass and also represents a worthwhile forage option for the crawfish farmer. Either of these plants is conveniently incorporated into existing farm operations and could provide options as producers strive to integrate crawfish aquaculture with conventional agriculture.

Table 1. Post-harvest ratoon ratings for three sorghums planted during June in crawfish ponds at the Rice Research Station, Crowley, LA. 1984-85.

Sorghum type	2-weeks post-harvest			5-weeks post-harvest		
	1984	1985	Mean	1984	1985	Mean
Forage sorghum	8 ^{1/}	5	6.4b	9	7	8.0b
Grain sorghum	5	7	5.8c	7	8	7.5b
Sorghum sudangrass	8	7	7.5a	10	9	9.3a
Year mean	6.9a	6.2b	6.6	8.5a	8.0a	8.3
CV (%)			8.7			8.3

^{1/} Ratoon ratings 1-10, where 1 = <10% regrowth, 2 = 10-20% regrowth, . . . 10 = 100% regrowth.

a,b,c Varietal means within any column, or year means in any row, not followed by the same letter are significantly ($P<0.05$) different according to Fisher's Protected LSD.

Table 2. Mean biomass production by three sorghums planted in crawfish ponds in late June and late August. Rice Research Station, Crowley, LA. 1984-85. SE are in parentheses.

Sorghum type ^{4/}	Planting date	Biomass at maturity ^{1/} (Hay or grain ^{2/})			Total biomass ^{3/}		
		1984	1985	Cultivar mean	1984	1985	Cultivar x PTD mean
Forage sorghum	June August	6146 (222) N/A	2317 (435) N/A	4232	7293 (358) 936 (98)	7502 (513) 1268 (36)	7399 1102
Grain sorghum	June August	1049 (33) N/A	3228 (62) N/A	2139	4555 (400) 1015 (150)	5125 (381) 1719 (473)	4840 1367
Sorghum sudangrass	June August	6834 (203) N/A	4943 (285) N/A	5888a	8226 (376) 1310 (237)	7672 (484) 1445 (40)	7949 1378
Year mean ^{5/} CV (%)		6489a	3630b	5060 15.6			23.5

1/ Hay and grain yields expressed as lb/A matter hectare.

2/ Grain yield adjusted to 13% moisture. Only June-planted grain sorghum was harvested for grain.

3/ Total biomass = hay + grain + ratoon; expressed as lb dry matter/acre.

4/ August-planted vegetation was not harvested for grain or hay. June-planted forage sorghum and sorghum sudangrass were not harvested for grain.

5/ Does not include grain yields from grain sorghum for biomass at maturity.

a,b,c Cultivar means within any column, planting date means within any row or column, or year means within any row, not followed by the same letter are significantly (P<0.05) different according to Fisher's Protected LSD.

Table 3. Post-flood biomass persistence of three sorghums planted in crawfish ponds at the Rice Research Station, Crowley, LA. 1984-85. SE are in parentheses.

Sorghum type	Planting date	2-year mean dry matter biomass (lb/A) --- weeks post-flood			
		Flood-up	6	12	18
Forage sorghum	June	1541 (73)	898 (41)	659 (70)	402 (19)
	August	1127 (140)	1082 (98)	625 (45)	256 (32)
	$\bar{x}$	1334b	990a	642a	329a
Grain sorghum	June	1702 (64)	1327 (77)	611 (40)	202 (10)
	August	1367 (94)	1072 (67)	538 (43)	273 (33)
	$\bar{x}$	1531a	1199a	574a	238a
Sorghum sudangrass	June	1724 (78)	938 (78)	638 (76)	256 (22)
	August	1377 (40)	1285 (50)	573 (11)	188 (11)
	$\bar{x}$	1551a	1112a	606a	222a
Planting date means					
	June	1656a	1055a	636a	287a
	August	1290b	1146a	579a	235a

a,b Cultivar means within any column, or planting date means within any column, not followed by the same letter are significantly ($P < 0.05$) different according to Fisher's Protected LSD.

EVALUATION OF SEVEN ALTERNATIVE FORAGES FOR CRAWFISH

M.W. Brunson, D.K. Riecke, and S.M. Simon

Seven potential alternatives to rice (*Oryza sativa*) as planted forage for pond production of crawfish in southwest Louisiana were evaluated. Browntop (*Panicum ramosum* L.), Japanese [*Echinochloa crusgalli* var. *frumentacea* (Roxb.) Wight], proso (*Panicum miliaceum* L.), and pearl [*Pennisetum typhoides* (Burn.) Stapf & C.E. Hubb] millets were compared with volunteer weeds (primarily *Cyperus* spp.), grain sorghum [*Sorghum bicolor* (L.) Moench] and a sorghum sudangrass hybrid [*S. bicolor* (L.) Moench]. Early maturation and rapid senescence and decomposition characterized all except the two sorghums and pearl millet. The sorghum sudangrass was superior in biomass production and exhibited slow senescence. Grain sorghum and pearl millet also exhibited characteristics which might be desirable for use in some crawfish production ponds.

Table 1. Mean stand ratings, days to 50% heading, dry matter biomass, and senescence ratings for seven terrestrial grasses planted in crawfish ponds in 1985 and 1986 at the Rice Research Station, Crowley, LA.

Vegetative type	Stand rating ^{1/}		Days to 50% heading	Dry matter biomass (lb/A)	Senescence ^{2/} rating
	2 Wk post- seeding	5 Wk post- seeding			
Browntop millet	8.6	8.9	72	2448	8.1
Japanese millet	8.4	9.0	71	3269	8.6
Proso millet	8.9	9.0	57	2868	9.5
Pearl millet	8.8	9.0	71	3935	4.5
Grain sorghum	8.5	9.0	62	3668	4.4
Sorghum sudangrass	8.9	9.0	70	5029	1.5
Weeds	6.0	7.5	54	3027	5.5
Mean	8.3	8.8	65	3463	6.0
CV%	7.7	4.6	2.9	20.2	11.4
1sd (0.05)	0.65	0.41	1.9	709	0.7

^{1/} Based on scale 1 to 9, where 1 = no stand and 9 = ideal stand.

^{2/} Based on scale 0 to 9, where 0 = no stem or leaf senescence, 1 = 1 to 10% . . . 9 = 81% or more stem or leaf senescence.

DOUBLE CROPPING CRAWFISH WITH GRAIN SORGHUM AND WITH RICE

M.W. Brunson, J.L. Griffin, D.K. Riecke, and S.M. Simon

Two crawfish (Procambarus spp.)/grain double cropping systems were compared over two production cycles in southwest Louisiana. Rice (Oryza sativa L.) grain production averaged 2845 lb/A, while grain sorghum [Sorghum bicolor (L.) Moench] yielded 3375 lb/A of grain. Straw and stubble dry matter present at the flooding of crawfish ponds was significantly ($P<0.05$) higher for rice (2935 lb/A) than for grain sorghum (1985 lb/A). Grain sorghum ratoon production (2297 lb/A) was approximately four times that of rice (511 lb/A). Rates of post-flood vegetative degradation and loss were similar during the first 6-week period, but thereafter retention of rice biomass was significantly higher than that of grain sorghum. Mean crawfish production was similar in both systems, and exceeded Louisiana statewide average yields by more than 3 to 1, averaging 2311 lb/A in 1985-86 and 1621 lb/A in 1986-87.

Table 1. Grain and vegetative biomass production in rice/crawfish and grain sorghum/crawfish double cropping systems at the Rice Research Station, Crowley, LA. 1985-86.

System	Grain yield (lb/A) ^{1/}			Straw/stubble DM production (lb/A)			Ratoon DM yield (lb/A)		
	1985	1986	x	1985	1986	x	1985	1986	x
Sorghum	2272b	4478a	3375a	2098b	1873b	1985b	2099a	2496a	2297a
Rice	2661b	3030b	2845a	2683a	3189a	2935a	574b	449b	511b

^{1/} Grain yields adjusted to 13% and 12% moisture for grain sorghum and rice, respectively.

a,b Two-year means within any column, or year means within any row, not followed by the same letter, are significantly different according to Fisher's Protected LSD ($P<0.05$).

Table 2. Post-flood biomass persistence and crawfish production in rice/crawfish and grain sorghum/crawfish double cropping systems at the Rice Research Station, Crowley, LA. 1985-87.

System	DM biomass (lb/A) ^{1/}				Crawfish production (lb/A)	
	Weeks post-flood				1985-86	1986-87
	0	6	12	18		
Sorghum	4283a	2034a	718a	353a	2323a	1640b
Rice	3446a	1671a	1221b	648b	2299a	1601b

^{1/} No differences ($P > 0.05$) were detected between years. Therefore, only two-year means are presented.

a,b DM biomass means within any column, or crawfish production means within any column or row, not followed by the same letter, are significantly different according to Fisher's Protected LSD ($P < 0.05$).

SORGHUM RATOON MANAGEMENT IN DOUBLE CROPPED CRAWFISH PONDS

M.W. Brunson, J.L. Griffin, D.K. Riecke, and S.M. Simon

Small plot studies were initiated in the spring of 1987 to determine optimum ratoon management methods for grain sorghum in crawfish/sorghum ponds.

Grain was harvested in late August, and yields averaged 3654 lb/acre. Stubble was subjected to all possible combinations of three treatment factors including cutting height (high, medium, low), fertilization (0 lb/acre and 50 lb/acre N), and crushing by heavy roller (roll, no roll). Cutting heights imposed were: high = standard harvest height, just below grain head; medium = mid-stalk; and low = ground level. Vegetation was sampled on 5 November and ratoon responses were determined.

Ratoon biomass was influenced only by cutting height and fertilization. Vegetative regrowth and plant height was maximized by addition of 50 lb/acre nitrogen immediately after harvesting plants at high cutting height (high/fertilized > medium/fertilized > low/fertilized = high/not fertilized = medium/not fertilized > low/not fertilized).

Biomass of the straw/stubble component remaining in November was influenced by cutting height, fertilization, and rolling. Increased cutting height resulted in greater retention of straw/stubble. Fertilization accelerated the straw/stubble decomposition rate, resulting in reduced retention, especially in rolled or low-cut vegetation. Straw/stubble retention was maximized by cutting plants high and not fertilizing.

Results from 1987 research indicate that forage production response in double cropped crawfish/sorghum ponds can be significantly influenced by both pre- and post-grain harvest treatment of the plants. Data from a second year of this study will provide a substantial basis for making recommendations on ratoon management in crawfish/sorghum ponds.

Rice remains the more important crawfish forage of the two crops, but recent studies at the Rice Research Station (Brunson 1987; Brunson and Taylor In Press; Brunson and Griffin In Press) established that sorghum can be effectively double cropped with crawfish and production is similar to that achieved in rice/crawfish systems. It is anticipated that a significant number of crawfish farmers will utilize sorghum in the coming season.

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FORAGE CROPS TISSUE CULTURE RESEARCH

BERMUDAGRASS IMPROVEMENT THROUGH TISSUE CULTURE

S.S. Croughan

INTRODUCTION

The objective of this project is to use biotechnology techniques to improve bermudagrass, an important forage grass in Louisiana. Somaclonal variants are produced from recommended varieties and breeding selections, then screened for increased yield, quality, persistence, and pest resistance. Initial laboratory and greenhouse screening identifies lines which show desirable characteristics. These plants are then vegetatively propagated, and established in field tests for further evaluation.

EXPERIMENT 1. Production of regenerated plants.

S.S. Croughan and K.M. Hebert

Callus production from stolon tissue was continued as previously described (see Croughan, Rice Research Station Annual Reports 1985 and 1986). Callus was cultured on several media sequences to trigger plant regeneration. In addition to previous varieties from which regenerated plants had been obtained, Grazer, OSU LCB W26, and Brazos, plants were regenerated from the Oklahoma selection OSU 71x6-7 and 86BRAZ-R1.

Callus production and subsequent plant regeneration from immature inflorescence was evaluated for several varieties on two media sequences (Table 1). Immature inflorescences were obtained from field grown material just prior to seed head emergence. Stems were collected, surface sterilized, and the inflorescence aseptically excised. Inflorescences were cultured on two nutrient media with varying levels of 2,4-D. As callus formed, it was transferred to the same nutrient medium with lower or no 2,4-D to trigger plant regeneration.

Callus formation occurred on immature inflorescences for most varieties, however complete plant regeneration was obtained in only seven varieties: Coastal, Grazer, Oklan, Brazos, 86OW26-R2, OSU 74x12-1, and OSU LCB W26. Early stages of regeneration were seen in other varieties, but development into complete plants has not yet occurred.

Callus production was much less and slower from immature inflorescences than from stolons. However, more plants per explant were regenerated from callus formed on immature inflorescence than from stolon-derived callus. It appears that stolons would be the best explant source if callus production was favored and immature inflorescence if large numbers of regenerated plants per explant were desired.

The amount of useful somaclonal variation obtained in the regenerated plants will be an important factor in determining the best explant source to use for germplasm enhancement. Preliminary data on stolon-derived regenerated plants suggests a large degree of variation has occurred, among which useful traits were observed (see Experiments 2, 3, and 4 below). The extent of somaclonal variation is currently being assessed among the immature inflorescence-derived regenerated plants. Data from other studies suggest that sufficient useful variation will be obtained in these regenerated plants as well.

Table 1. Bermudagrass callus formation and plant regeneration from immature inflorescences.

Bermudagrass Variety	No. of Inflorescences	Callus Formation	Plant Regeneration
Coastal	299	+	+
Grazer	97	+	+
Tifton 292	13	+	-
Alicia	87	+	-
Callie	14	-	-
Hardie	8	+	-
Oklan	1	+	+
Tifton 44	11	+	-
Brazos	183	+	+
OSU LCB W26	78	+	+
OSU 74x12-1	78	+	+
86GRAZ-R1	3	-	-
86OW26-R1	3	+	-
86OW26-R2	15	+	+

EXPERIMENT 2. Screening for resistance to Helminthosporium cynodontis.

M.D. Richardson, S.S. Croughan, and D.E. Groth

Leaf spot disease, caused by the fungus Helminthosporium cynodontis, can reduce yields, weaken plants, and decrease stand persistence of bermudagrass pastures. Somaclonal variants regenerated from stolon-derived callus were screened for increased tolerance to this disease.

Toxin was produced as described before (see Croughan, Rice Research Station Annual Report 1986). Leaves from greenhouse grown material were floated on solutions containing toxin for 24 hours. Several dilutions were used to test for different levels of sensitivity to the toxin.

The regenerated plants developed from Grazer and OSU LCB W26 (86GRAZ-R1, 86OW26-R1, and 86OW26-R2), were not significantly more resistant to the toxin produced from H. cynodontis cultures. Three of the four regenerated lines developed from Brazos were significantly more resistant than Brazos.

Somaclonal variation was successful in producing useful variation in disease resistance in plants regenerated from bermudagrass callus.

Table 2. Susceptibility of regenerated bermudagrass lines to the toxin produced from Helminthosporium cynodontis.^a

Regenerated Line ^b	% Toxin Concentration (vol./vol.)						
	100	80	60	40	20	10	0
86GRAZ-R1 (1)	ns	ns	ns	ns	ns	ns	ns
86BRAZ-R1 (2)	*	**	**	ns	ns	ns	ns
86BRAZ-R2 (2)	***	***	**	*	ns	ns	ns
86BRAZ-R3 (2)	***	***	**	ns	ns	ns	ns
86BRAZ-R4 (2)	ns	ns	ns	ns	ns	ns	ns
86OW26-R1 (3)	ns	ns	ns	ns	ns	ns	ns
86OW26-R2 (3)	ns	ns	ns	ns	ns	ns	ns

^a Each regenerated line was contrasted to the variety from which it was developed: values were significantly different (***= P<0.001, ** = P<0.01, * = P<0.09) or not significant (ns).

^b Variety from which line was developed: (1) = Grazer, (2) = Brazos, (3) = OSU LCB W26.

Experiment 3. Screening for resistance to the fall armyworm, Spodoptera frugiperda.

S.S. Croughan and S.S. Quisenberry

The fall armyworm is a major insect problem in bermudagrass pastures. A severe infestation can reduce yields and quality of the forage as well as weaken stands. Somaclonal variants regenerated from stolon-derived callus were screened for increased resistance to fall armyworm.

Seven regenerated lines and the three varieties from which they were developed were grown in metal flats in a greenhouse. Plants were clipped approximately every 4 weeks to a 7 cm stubble height and fertilized with complete fertilizer. The fall armyworm colony was maintained on a modified pinto bean diet in a growth chamber.

A total of 50 larvae were tested on each grass. After 2 weeks regrowth, leaves from each plant type were excised, wrapped in moistened cheesecloth, and brought to the laboratory for feeding studies. One neonate larva was placed in a petri dish that contained excised leaves on moistened cellulose wadding. Leaves were replaced after 2 days, and daily thereafter. Larval weights on day 6 and 8, pupal weights, larval duration, and mortality were monitored. Relative growth rate was calculated as: $[\ln(\text{day 8 weight}) - \ln(\text{day 6 weight})] / 2$. Regenerated lines were contrasted to the variety from which they were developed.

Fall armyworm larvae fed leaves from the regenerated line developed from Grazer (86GRAZ-R1) had significantly smaller weights on day 6 and 8, however

the pupal weight was significantly larger. Larvae fed leaves from the four regenerated lines developed from Brazos (86BRAZ-R1 through 86BRAZ-R4) all had significantly smaller weights on either day 6 or day 8 except for 86BRAZ-R2. All had significantly smaller pupal weights and larvae fed leaves of 86BRAZ-R3 also had a longer larval duration and smaller relative growth rate. Larvae fed leaves from 86OW26-R1 were not significantly different than those fed leaves of OSU LCB W26, while those fed leaves from 86OW26-R2 were significantly smaller and had longer larval duration. The fall armyworm mortality was highest among those fed leaves of 86GRAZ-R1 and 86OW26-R2.

Based on the larval performance when fed the leaves from the different bermudagrass lines, it appears that several of the regenerated lines have increased resistance to fall armyworm. Somaclonal variation appears to be a useful method for producing improved insect resistance in bermudagrass varieties.

Table 3. Resistance of regenerated bermudagrass lines to fall armyworm.^a

Regenerated line ^b	Larval weight		Larval duration	Pupal weight	Relative growth rate	% mortality ^c
	Day 6	Day 8				
86GRAZ-R1 (1)	**	**	ns	***	ns	+16
86BRAZ-R1 (2)	*	ns	ns	***	ns	+ 2
86BRAZ-R2 (2)	ns	ns	ns	**	ns	- 2
86BRAZ-R3 (2)	ns	**	***	***	***	+ 6
86BRAZ-R4 (2)	ns	*	*	***	ns	- 4
86OW26-R1 (3)	ns	ns	ns	ns	ns	+ 4
86OW26-R2 (3)	*	**	**	***	ns	+24

^a Each regenerated line was contrasted to the variety from which it was developed: values were significantly different (***) = $P < 0.001$, ** = $P < 0.05$, * = $P < 0.01$ or not significant (ns).

^b Variety from which line was developed: (1) = Grazer, (2) = Brazos, (3) = OSU LCB W26.

^c Increase (+) or decrease (-) in % mortality over the variety from which the line was developed.

Experiment 4. Field evaluation of regenerated bermudagrass lines.

S.S. Croughan, K.M. Hebert, M.M. Eichhorn, Jr., W.M. Oliver, and B.D. Nelson

In order to accurately evaluate the performance of the regenerated bermudagrass lines, field tests are necessary. Field tests in 1987 were conducted at the Rice Research Station in Crowley and the Hill Farm Research Station in Homer. Data will be collected for at least three years and lines which consistently perform well will be selected for further testing in

expanded field tests and animal performance trials. For results of the field tests at the Hill Farm Research Station, see the 1987 annual report for project no. 2165 at the Hill Farm Research Station, Homer, Louisiana.

Field plots (8 x 8 ft) were established in Crowley on May 13. Small clumps of sprigs were planted in the center of each plot and fertilized with 300 lb NH_4NO_3 and 500 lb 0-20-20, with an additional 300 lb of NH_4NO_3 on July 21. Weed⁴ control consisted of the application of Princep (2 lb/A)⁴ at planting, two applications of MSMA (2 qt/A) during the growing season and spot spraying with 3% Roundup to control common bermudagrass. Plots were rated on July 17 and August 17 for stand establishment and harvested on August 25 and September 29. At each harvest, a subsample of grass was collected, dried at 80°C for 7 days, then ground through a Willey mill (mesh = 1 mm). Samples were sent to the Southeast Research Station for quality analysis.

From the first year's data it appears that the regenerated line developed from Grazer, 86GRAZ-R1, has about equal yield potential, but a slight increase in rate of establishment over Grazer. The regenerated lines developed from Brazos show varying changes in rates of establishment and yield. One line, 86BRAZ-R4, has a better establishment rate than Brazos, while three lines, 86BRAZ-R1, 86BRAZ-R2, and 86BRAZ-R4 appear to have a higher yield potential. The two lines developed from OSU LCB W26 were equal or worse for establishment rate and yield when compared to OSU LCB W26. Plots will be monitored for at least three more years to verify yield differences and persistence of the grasses.

Plants regenerated from callus show variation in several traits. It appears that this method has potential for producing useful germplasm for bermudagrass improvement.

Table 4. Field performance of regenerated bermudagrass lines.

Bermudagrass line ^a	Establishment ^b	Yield ^b
86GRAZ-R1 (1)	+	=
86BRAZ-R1 (2)	=	+
86BRAZ-R2 (2)	+	+
86BRAZ-R3 (2)	-	-
86BRAZ-R4 (2)	+	+
86OW26-R1 (3)	=	=
86OW26-R2 (3)	-	-

^a Variety from which line was developed: (1) = Grazer, (2) = Brazos, (3) = OSU LCB W26.

^b Each regenerated line was contrasted to the variety from which it was developed: increase (+), decrease (-), or equal (=) performance.

ALFALFA IMPROVEMENT THROUGH TISSUE CULTURE

S.S. Croughan and K.M. Hebert

INTRODUCTION

The objective of this project is to use biotechnology techniques to improve alfalfa, an important forage legume. Improvement is needed in the yield, persistence and quality of alfalfa grown in Louisiana. Somaclonal variants are being produced through cell culture techniques and then screened for plants which are better adapted to the environmental conditions in this state.

Callus initiation and plant regeneration are as previously described (see Croughan, Rice Research Station Research Reports for 1985 and 1986). Plants have been regenerated from all varieties tested. Regeneration efforts for producing somaclonal variants has focused on the varieties Florida 77, Apollo and Southern Special.

Regenerated plants established in the field in the fall of 1986 were observed for general performance. Insect control consisted of two applications of Furadan (1/2 lb ai/A) and two applications of Sevin (1 lb ai/A) between March 19 and July 14. Weed control consisted of one application of Eptam (3 lb ai/A) and three applications of Poast (1%). Plants were fertilized with 600 lb/A of 0-20-20 on April 13, and harvested on May 4 and June 2.

While in the field, plants were monitored for insect damage, incidence of disease, morphological changes from check plants of each variety, overall health and growth habit, height, harvest weight, and leaf to stem ratio. On July 14, 89 of 398 plants were identified as superior based on the above characteristics, removed from the field and placed in 5 gal pots. Vegetative cuttings were made from these plants for additional laboratory screening procedures.

Additional studies involved developing the techniques for genetic engineering alfalfa using Agrobacterium. Aseptic alfalfa seeds were germinated and the cotyledons removed, then dipped in a solution containing bacteria which has specific plasmids coding for the gene cecropin B, an antimicrobial gene, and for resistance to kanamycin. The cotyledons were placed on callus induction medium containing kanamycin. Only cells which have been transformed will form callus, which is then transferred to regeneration medium for development of transformed plants. Callus has been obtained which will grow on kanamycin containing medium. The callus is currently being cultured on regeneration medium for the production of plants.

BEEF CATTLE NUTRITION RESEARCH

INFLUENCE OF SUPPLEMENTAL PROTEIN AND LASALOCID FOR GRAZING STEERS

T.W. White, M. Craig, and M. Jordan

INTRODUCTION

In previous grazing experiments at this station, supplemental protein has not improved steer performance beyond that of supplemental energy. This experiment was initiated to study the influence of lasalocid on grazing steers supplemented with protein and energy.

MATERIALS AND METHODS

Thirty-six Hereford x Angus crossed steers averaging 518 pounds were blocked by weight and randomly assigned to four supplemental treatments to grazing. The treatments were two pounds of ground shelled corn or one pound of ground shelled corn and one pound of soybean meal per head per day with and without 200 milligrams of lasalocid per head per day. Each treatment group was assigned to a 3.3 acre dallisgrass pasture initially and rotated every 28 days so that all treatment groups grazed all pastures for 28 days. The experiment was initiated in late May and continued for 112 days with initial and 28-day weights taken after a 16-hour shrink.

RESULTS AND DISCUSSION

Replacing one pound of corn with one pound of soybean meal did not improve average daily gain when fed with (1.12 vs. 1.01 lb) or without (.82 vs. .79 lb) lasalocid. Feeding 200 mg. lasalocid improved ($P < .05$) average daily gain.

SUMMARY

Two pounds of corn or one pound of corn and one pound of soybean meal provided equal responses for grazing steers. Feeding lasalocid improved the gains of steers fed the two supplements from 27 to 36%.

INFLUENCE OF FISH MEAL LEVEL AND GRAIN TYPE IN DIETS FOR FINISHING STEERS

T.W. White, L.S. Sticker, and F.G. Hembry

INTRODUCTION

Dietary protein entering the rumen is degraded and utilized by the microorganisms or escapes into the abomasum and lower gastrointestinal tract where it is degraded to amino acids that are absorbed. Some proteins are degraded less than others in the rumen and therefore may be of greater nutritional value. Fish meal is a high protein product of south Louisiana that has received only limited attention as a ruminant protein source in the United States but should have rumen by-pass qualities since heat is used in the oil extraction process.

Rice has not been thoroughly investigated as a feed grain because of its demand as a human food source. Recent rice surpluses have created an interest in feeding rice to beef cattle. Limited research at this station suggests that milled rice is equal to corn for finishing steers. This experiment was conducted to compare milled rice and corn with five levels of fish meal for finishing steers.

MATERIALS AND METHODS

One-hundred Hereford x Angus crossed steers averaging 557 lb were implanted with 36 mg Zeranol and blocked by weight into 10 groups in each of two years. One steer from each weight group was randomly assigned to each of 10 treatments. A 2 x 5 factorial design was used to compare milled rice and corn with five levels of menhaden fish meal. The ration contained 20% ground grass hay, 10% molasses, 1% dicalcium phosphate, .5% trace mineralized salt, .5% urea, 330 I.U. vitamin A per pound of feed, 63 to 64% ground grain and 0, .95, 1.90, 2.85 or 3.80% fish meal. Soybean meal was added to provide 11% crude protein rations.

The steers were denied feed and water for 18 hr prior to weighing initially and at 28-day intervals. Ruminal samples were taken via stomach tube near the end of the feeding period for VFA determination. Steers were slaughtered after 156 days. Carcass characteristics were evaluated by USDA graders and longissimus muscle area and fat thickness were measured on the cut surface at the 12th rib 48 hr after slaughter.

RESULTS AND DISCUSSION

The results of feeding five levels of fish meal and two grains are shown in table 1. Fish meal did not consistently influence gains. Average daily gains were highest ($P < .05$) when rations contained 3.80% fish meal, however gains were lowest ($P < .05$) with 0 and 2.85% fish meal. Carcass weight, fat thickness, and marbling score followed this same general trend. Fish meal level did not influence quality grade or longissimus area.

Table 1. Performance of steers fed five levels of fishmeal with milled rice and corn. Rice Research Station, Crowley, LA. 1986 and 1987.

Item	Percent fish meal					Grain	
	0	.95	1.90	2.85	3.80	Milled rice	Corn
No. steers	40	40	40	40	40	100	100
Initial wt, lb	558	558	556	557	558	557	557
Days on feed	156	156	156	156	156	156	156
Feed intake, lb	22.9	23.2	24.0	23.6	24.3	22.3	24.8
Daily gain, lb	2.22 ^b	2.33 ^{ab}	2.38 ^{ab}	2.23 ^b	2.47 ^a	2.24 ^e	2.41 ^d
Carcass wt, lb	528 ^b	541 ^{ab}	543 ^{ab}	533 ^b	552 ^a	526 ^e	553 ^d
Marbling score ^f	7.6 ^b	8.0 ^{ab}	8.4 ^{ab}	8.3 ^{ab}	8.9 ^a	7.6 ^e	8.9 ^d
Quality grade ^g	9.8	10.1	10.2	10.2	10.3	9.6 ^e	10.7 ^d
Fat thickness, in	.30 ^b	.31 ^{ab}	.33 ^{ab}	.33 ^{ab}	.35 ^a	.29 ^e	.37 ^d
Longissimus muscle area, sq in	10.0	9.9	10.2	10.0	10.2	10.0	10.1

abc Means of the fish meal levels on the same line that do not have a common superscript letter differ (P<.05).

de Means of the grain type on the same line that do not have a common superscript letter differ (P<.05).

f Slight minus = 7; Slight = 8; Slight plus = 9.

g Good minus = 9; Good = 10; Good plus = 11.

Including milled rice in the ration resulted in lower ($P<.05$) gains, carcass weight, marbling score, fat thickness, and quality grade in comparison to corn. There was an interaction ($P<.05$) for grain type and fish meal level on longissimus muscle area and carcass weight.

Ruminal fluid characteristics are shown in Table 2. The proportion of acetate was higher ($P<.05$) when 3.80% fish meal was included in the diet than when .95, 1.90, or 2.85% fish meal was used. Propionate level tended to be higher with 3.80% fish meal but was different ($P<.05$) only from the 2.85% fish meal diet. The pH of ruminal fluid from steers fed milled rice was higher ($P<.05$) than when corn was fed.

SUMMARY

A 2 x 5 factorial design was used to compare milled rice and corn with five levels of fish meal in 20% roughage rations in each of two years. Fish meal was included in the rations at 0, .95, 1.90, 2.85 or 3.80% with soybean meal used to balance the ration to 11% crude protein. One-hundred Hereford x Angus crossed steers were blocked by weight and randomly assigned to 10 treatments in each of two years. Average daily gain, carcass weight and marbling scores were higher ($P<.05$) at the 3.80% fish meal level than at the 0 level, which tended to be lower than at the .95 and 1.90% levels. Gains, carcass weight, marbling scores, fat thickness, and quality grades were higher ($P<.05$) when corn was fed than when rice was fed. There was an interaction ($P<.05$) for grain type and fish meal level on carcass weight.

Table 2. Volatile fatty acid concentration^a and pH of ruminal fluid from steers fed various levels of fish meal and either milled rice or corn. Rice Research Station, Crowley, LA. 1987.

Item	Percent fish meal				Grain	
	0	.95	1.90	2.85	3.80	Milled rice Corn
Acetate	65.0 ^{bc}	67.1 ^b	67.0 ^b	67.5 ^b	63.8 ^c	66.7 65.5
Propionate	21.7 ^{bc}	20.4 ^{bc}	19.9 ^{bc}	19.0 ^c	22.5 ^b	20.2 21.1
Butyrate	13.3	12.6	13.1	13.7	13.7	13.1 13.4
Total VFA	118	115	114	115	120	118 114
pH	6.60	6.69	6.76	6.63	6.58	6.71 ^d 6.59 ^e

^a Concentration of individual acids expressed as moles per 100 moles of total acids. Total VFA expressed as micromoles per milliliter of ruminal fluid.

^{bc} Means of fish meal levels on the same line that do not have a common superscript letter differs (P<.05).

^{de} Means of grain type on the same line that do not have a common superscript letter differs (P<.05).

INFLUENCE OF SHADE AND FEEDLOT SURFACE ON PERFORMANCE OF STEERS CONSUMING A HIGH FORAGE DIET

T.W. White, F.G. Hembry, M. Craig, and G. Romero

INTRODUCTION

Previous research at this station has shown that while gains by grazing steers were not influenced by shade, steers fed green chopped forage or an 80% hay diet in partially covered concrete pens gained more than steers in dirt pens with or without shade. Gains by steers grazing summer forage are not usually as high as in some areas, and attempts are being made to relate this to the environment. This experiment was designed to study the influence of shade and feedlot surface on performance of steers fed an 80% hay diet.

MATERIALS AND METHODS

Thirty-six Hereford x Angus crossed steers averaging 551 lb were blocked by weight into nine groups. One steer from each weight group was randomly assigned to each of four treatments. The treatments were concrete and dirt pens with and without shade. An 80% hay ration also containing 5% corn, 3% cottonseed meal, 10% molasses, 1% urea, .5% trace mineralized salt, .5% dicalcium phosphate, and vitamin A was fed to steers on all treatments. This experiment was initiated on May 26 and continued for 84 days. All weights were taken after a 16-hr shrink without feed or water. Plain mercury and black bulb thermometers in several locations in the pens were read at 8 am, 12 noon, and 4 pm, and weather conditions recorded Monday through Friday during the experiment. Black bulb thermometers were plain mercury thermometers inserted in a 4-inch diameter black metal bulb.

RESULTS AND DISCUSSION

Performance of steers on this experiment is shown in Table 1. Shade increased ($P<.05$) average daily gains when steers were fed in concrete pens but had no influence when steers were fed in dirt pens. Gains were slightly higher when steers were fed in dirt pens without shade than when shade was provided. The former steers stood in a mud hole that developed after heavy rain that may have provided some cooling and improved gains.

Table 1. Influence of shade and feedlot surface on performance of steers fed a high forage diet. Rice Research Station, Crowley, LA. 1987.

Treatment	Average daily gain, lb	Feed intake, lb
Concrete - shade	1.95 ^a	23.5
Concrete - no shade	1.15 ^c	21.5
Dirt - shade	1.32 ^{c,b}	22.5
Dirt - no shade	1.52 ^b	22.6

abc Means in the same column bearing different superscripts differ ($P<.05$).

Feed intake was lowest when steers were fed in concrete pens without shade, but the differences between treatments were not great enough to explain the depressed gains.

The relationship between temperature or percentage cloud cover and average daily gains is shown in Table 2. Gains by steers in concrete pens with shade were related to very few of the temperature or cloudiness measurements. In contrast, most temperature measurements were negatively related to gain in dirt pens with or without shade and concrete pens without shade. The positive relationship between gains and temperature is without explanation at this time.

Table 2. Correlation coefficients ($P < .05$) between average daily gain, temperature, and cloudiness. Rice Research Station, Crowley, LA. 1987.

Treatment	AAB ^a	APB	MBB	MPB	A-cloud	M-cloud
8:00 am						
Concrete - shade	--	--	-.60	-.60	--	.73
Concrete - no shade	--	--	.74	--	--	-.51
Dirt - shade	-.52	-.52	.49	.49	.39	--
Dirt - no shade	-.59	-.56	.59	--	.47	--
12:00 noon						
Concrete - shade	--	--	--	--	-.52	--
Concrete - no shade	-.57	-.65	-.56	-.62	.75	--
Dirt - shade	-.77	-.77	-.61	-.61	.77	--
Dirt - no shade	-.59	-.59	-.58	-.60	.45	--
4:00 pm						
Concrete - shade	--	--	--	--	--	--
Concrete - no shade	-.45	-.47	--	-.56	.51	--
Dirt - shade	-.61	-.61	-.49	-.49	.72	--
Dirt - no shade	-.58	-.58	-.57	-.59	-.60	--

^a ABB = Average black bulb temperature; MBB = Maximum black bulb temperature; APB = Average plain bulb temperature; MPB = Maximum plain bulb temperature; A-cloud = Average cloudiness; M-cloud = Maximum cloudiness.

SUMMARY

Thirty-six Hereford x Angus crossed steers were blocked by weight and assigned to four treatments which were concrete or dirt pens with and without shade. All steers were fed an 80% forage diet. Shrink weights were taken at 28-day intervals during the 84-day experiment with 8 am, 12 noon, and 4 pm plain and black bulb temperature and percentage cloud cover recorded daily except on weekends. Average daily gains were highest ($P < .05$) when steers were in concrete pens with shade and lowest when steers were in concrete pens without shade. Gains by steers in dirt pens were not influenced by shade. Correlation coefficients suggest that steers in concrete pens with shade were not influenced by temperature as much as steers in dirt pens or concrete pens without shade.

INTERNATIONAL RICE TRAINING PROGRAM

Maurice F. Miller

The Rice Research Station has cooperated for a number of years with the Foreign Training Division of the International Agricultural Development Service by providing an informative training program for international leaders, farmers, and others interested in the production of rice.

Data regarding the classification of visitors according to countries are presented in Table 1. A total of 132 participants representing 16 countries were guests at the Rice Research Station in 1987. This was a decrease from the 140 participants in 1986. France provided the largest number of visitors.

Table 1. Number of participants according to country. Rice Research Station, Crowley, LA. 1987.

Country	Number of participants
Australia	1
Belgium	6
Brazil	6
Canada	12
China (PROC)	2
France	34
Germany (West)	25
India	6
Iraq	4
Ivory Coast	5
Italy	18
Jamaica	6
Japan	4
Madagascar	1
Pakistan	1
Sierra Leone	1
TOTAL	132

Table 2 presents information regarding the number of participants according to sponsoring organizations. The largest number was self sponsored.

Subject matter of interest to the participants varied from general rice production practices to specific interests, such as plant breeding, processing and marketing, and control of rice diseases, insects, and weeds. There was also interest in biotechnology, farm management, the rotation of rice and crawfish, and administrative problems and practices.

Table 2. Number of visitors according to sponsoring organizations. Rice Research Station, Crowley, LA. 1987.

<u>Sponsoring organization</u>	<u>Number sponsored</u>
ANGA	1
APA	2
CODOFIL	30
FAA	25
FAO/USDA	1
Foreign Governments	1
Louisiana Farm Bureau	2
Rice Council	10
Rotary International	5
Self	40
USAID	7
USDA	5
USIA	<u>3</u>
TOTAL	132

ECONOMICS OF ENTERPRISE SELECTION AND WHOLE FARM
DECISION MAKING IN THE LOUISIANA RICE GROWING AREAS^{1/}

Thomas P. Zacharias and Brian E. McManus^{2/}

Enterprise budget projections for 1988 were developed for rice, soybeans, milo, corn, wheat, wheat-soybean double crop, and a rice-crawfish double cropping system. A summary of the enterprise budgeting analysis for Southwest Louisiana is presented in Table 1. Budgeting results for rice production in Northeast Louisiana are shown in Table 2. Owner-operator and tenant-operator situations were budgeted for each enterprise with the exception of the rice-crawfish double cropping system. Other than rice, all enterprises were valued at the government loan support price or at a projected market price. The rice enterprise was valued at the loan rate price plus the deficiency payment. Under these assumptions, sufficient revenue was available to cover direct expenditures for all but the tenant-operator soybean and milo enterprises. Direct expenditures were defined to be seed, fuel, fertilizer, labor, chemicals, maintenance on equipment, and interest on operating capital. Total specified expenses include direct expenditures plus the annualized cost of replacing capital assets. All tenant situations for all enterprises except rice exhibited negative returns above the total specified expenses. The milo and wheat-soybean enterprises were the only owner-operator situations that did not generate sufficient revenues to cover total specified expenses.

Detailed enterprise budgets and supporting data were published in A.E.A. Research Reports, Numbers 60 and 61, January 1988.

Service enterprise budgets were prepared for several alternative rice irrigation systems in Southwest Louisiana. Cost estimates were developed for diesel, electric, and natural gas power systems. Deep well and surface water sources for each of the above power systems were evaluated. Per acre inch direct irrigation costs for a deep well water source were estimated to be approximately \$1.88, \$2.57, and \$1.54 for diesel, electric, and natural gas systems, respectively. Total per acre inch irrigation costs for a deep well water source were estimated to be approximately \$3.18, \$3.64, and \$2.82 for diesel, electric, and natural gas systems, respectively. Per acre inch direct irrigation costs for a surface irrigation water source were estimated to be approximately \$0.83, \$0.96, and \$0.67 for diesel, electric, and natural gas systems, respectively. Total per acre inch irrigation costs for a surface irrigation water source were estimated to be approximately \$1.55, \$1.56, and \$1.38 for diesel, electric, and natural gas systems, respectively. Detailed results of the irrigation cost analysis are reported in A.E.A. Research Report Number 61, January 1988.

^{1/} Research supported in part by funds provided by Louisiana rice producers through the Louisiana Rice Research Board.

^{2/} Assistant Professor and Research Associate, respectively, Department of Agricultural Economics and Agribusiness, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, Louisiana.

Table 1. A Summary of Projected Costs and Returns per Acre For Rice, Soybeans, Corn, Milo, Wheat, Wheat-Soybean Double-Crop, and Rice-Crawfish Double Crop Enterprises, Southwest Louisiana, 1988.^a

Crop Description ^{b/}	Yield Per Acre	Unit	Total Income	Direct Expenses	Returns	Fixed Expenses	Total Expenses	Returns
----- Dollars Per Acre -----								
<u>Rice Enterprises:</u>								
Water Plant, Owner ^{c/} Water Plant, Tenant ^{d/}	46.10	cwt.	520.93	358.69	162.24	90.12	448.80	72.13
Dry Plant, Owner ^{c/} Dry Plant, Tenant ^{d/}	27.66	cwt.	312.56	228.12	84.44	46.73	274.85	37.71
Second Cutting ^{c/}	48.55	cwt.	548.61	342.35	206.26	93.85	436.20	112.41
	29.13	cwt.	329.17	215.72	113.45	50.47	266.19	62.98
	9.64	cwt.	108.93	67.91	41.02	30.01	97.92	11.01
<u>Soybean Enterprises:</u>								
6-Row, Owner ^{c/} 6-Row, Tenant ^{d/}	24.50	bu.	116.86	115.83	1.03	35.04	150.87	-33.99
Drill Plant, Owner ^{c/} Drill Plant, Tenant ^{d/}	19.60	bu.	93.49	114.52	-21.03	35.04	149.56	-56.07
	27.00	bu.	128.79	120.66	8.13	34.05	154.71	-25.92
	21.60	bu.	103.03	119.15	-16.12	34.05	153.20	-50.17
<u>Corn Enterprises</u>								
6-Row, Owner ^{c/} 6-Row, Tenant ^{d/}	100.00	bu.	173.00	151.70	21.30	38.53	190.23	-17.23
	80.00	bu.	138.40	148.14	-9.74	38.53	186.67	-48.27
<u>Milo Enterprises:</u>								
Drill Plant, Owner ^{c/} Drill Plant, Tenant ^{d/}	44.43	cwt.	131.07	98.09	32.98	27.74	125.83	5.24
	35.54	cwt.	104.85	98.09	6.76	27.74	125.83	-20.97

Continued.

Table 1. (Continued).

Crop Description ^{b/}	Yield Per Acre	Unit	Total Income	Direct Expenses	Returns	Fixed Expenses	Total Expenses	Returns
----- Dollars Per Acre -----								
<u>Wheat Enterprises</u>								
Drill Plant, Owner ^{c/}	45.00	bu.	97.65	74.04	23.61	25.27	99.31	-1.66
Drill Plant, Tenant ^{d/}	36.00	bu.	78.12	74.04	4.08	25.27	99.31	-21.19
<u>Wheat-Soybean Double Crop</u>								
Wheat-Soybean, Owner ^{c/}	45+25	bu.	216.90	151.72	65.18	45.01	196.73	20.17
Wheat-Soybean, Tenant ^{d/}	36+20	bu.	173.52	152.70	20.82	45.01	197.71	-24.19
<u>Rice-Crawfish Double Crop ^{e/}</u>								
Rice-Crawfish, Owner ^{c/}	4,200+800	lbs.	663.00	518.00	145.00	193.28	711.28	-48.28

^{a/} Crop prices used were \$11.30 per hundredweight for rice, \$4.77 per bushel for soybeans, \$2.95 per hundredweight for milo, \$2.17 per bushel for wheat, and \$1.73 per bushel for corn.

^{b/} Rental arrangements for rice were 1/5 crop share for land and 1/5 crop share for water with both landlord and waterlord paying 1/5 of fertilizer, chemicals, and drying and storage costs and the waterlord paying for all the irrigation fuel. Rental arrangements for soybeans and milo, and wheat were 1/5 crop share for land with the landlord paying 1/5 of drying and storage costs.

^{c/} Land costs are not included.

^{d/} Includes land rent based on representative crop-sharing arrangements for the area.

^{e/} Rice was valued at the loan rate of \$6.50 per hundredweight. Average monthly prices for live crawfish were \$.60, \$.50, and \$.40 for January, February, and March, respectively.

Table 2. A Summary of Projected Costs and Returns Per Acre For Rice Production, Mississippi Delta and Ouachita Areas, Louisiana, 1988.^{a/}

Description ^{b/}	Yield Per Acre	Unit	Total Income	Total Direct Expenses	Above Direct Expenses	Total Fixed Expenses	Total Specified Expenses ^{c/}	Above Specified Expenses ^{d/}
----- Dollars Per Acre -----								
Rice, Water Planted, Owner	48.60	cwt.	549.18	282.25	266.93	77.27	359.52	189.66
Rice, Water Planted, Tenant	29.16	cwt.	329.51	231.85	97.66	46.51	278.36	51.15
Rice, Drill Planted, Owner	48.60	cwt.	549.18	277.43	271.75	81.80	359.23	189.95
Rice, Drill Planted, Tenant	29.16	cwt.	329.51	224.86	104.65	51.03	275.89	53.62

^{a/} Crop price used for rice was \$11.30 per cwt. This is the 1988 target price for rice which consists of the loan price (\$6.50 per cwt.) and deficiency payment (\$4.80 per cwt.)

^{b/} Rental arrangements for rice were 1/5 crop share for land and 1/5 crop share for water.

^{c/} Farm overhead expenses are not included in total specified expenses.

^{d/} Land costs are not included in total specified expenses for owner-operators.

An economic analysis of laser leveling rice fields in Louisiana was conducted to compare the costs and benefits of land leveling. A survey was completed on laser equipment dealers and rice farms that had been leveled. A summary of the survey information is presented in Table 3. Using information from the survey, fixed and operating costs were estimated. Operating and total costs per cubic yard of soil moved were approximately \$0.25 and \$0.48, respectively. Benefits from land leveling include irrigation cost savings and increased yields. To estimate the benefits, representative situations for Northeast Louisiana rice farms were developed, and a comparison was made between non leveled fields and laser leveled fields. Estimated per acre cost savings on drill planted rice fields were \$11.01 and \$11.62 for a surface water system and a well water system, respectively. Reported yield increases from laser leveling ranged from 0 to 24.3 cwt. per acre, and corresponding net returns ranged from \$0.00 to \$127.33 with a median value of \$75.46. To analyze the laser system investment, a representative farm of 250 rice acres was developed. The payback period method was selected as the analysis tool. This method calculates the number of years needed to pay back an investment using future returns. Payback periods are presented in Table 4. At the lower yield increases, increased returns from laser leveling are not enough to cover the cost of the system. For this representative situation, average annual laser benefits from cost savings and yield increases were \$0.02 and \$0.24 per cubic yard, respectively. Cost savings alone are not enough to pay for the system, and a yield increase of 5.5 cwt. per acre is needed to break even.

Table 3. Summary of survey results and cost estimates, laser leveling rice fields, Louisiana, 1987.

Present rice areas laser leveled	20,612
Other crop acres laser leveled	4,335
Average cubic yards per acre moved on rice fields	350
Maximum cubic yards per acre	500
Minimum cubic yards per acre	200
Average grade per 100 ft.	0.11
Average hired cost per cuyd	0.59
Average rice yield per acre (cwt. dry)	57.45
Average increased yield per acre	8.57
Maximum increased yield per acre	20.25
Depth of main flood	3 to 5 inches
 Laser equipment purchase price	 \$16,000
Drag scraper purchase price	\$8,500
Expected life of laser equipment	10 years
 Laser leveling costs per hour	
Fuel costs	\$6.48
Repair costs	\$8.03
Labor costs	\$5.00
Fixed costs	\$18.56
Total costs	\$38.07
 Laser leveling costs per cubic yard	
Fuel costs	\$0.081
Repair costs	\$0.100
Labor costs	\$0.063
Fixed costs	\$0.232
Total costs	\$0.476

Table 4. Payback Periods For Laser Leveling 250 Acre Rice Fields, Owned Equipment vs. Contracted, At Different Yield Increases and Cubic Yards, Drill Planted Rice, Northeast Louisiana. 1987.

	Surface Water			Well Water		
	200	350	500	200	350	500
	(Cubic Yards)			(Cubic Yards)		
Yield Increase						
<u>Owned Equipment</u>						
Minimum	>10	>10	>10	>10	>10	>10
	7	9	>10	7	9	10
Median	2	3	4	2	3	4
	2	3	3	2	3	3
Maximum	2	2	3	2	2	3
<u>Contracted</u>						
Minimum	>10	>10	>10	>10	>10	>10
	9	>10	>10	9	>10	>10
Median	2	3	3	2	3	3
	2	2	3	2	2	3
Maximum	1	2	2	1	2	2

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Gerard T. Berggren, Jr.-----Soybean Diseases

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