

77th Annual Progress Report
RICE RESEARCH STATION

Crowley, Louisiana
1985

LOUISIANA
AGRICULTURAL EXPERIMENT STATION
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AGRICULTURAL CENTER
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U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURE RESEARCH SERVICE
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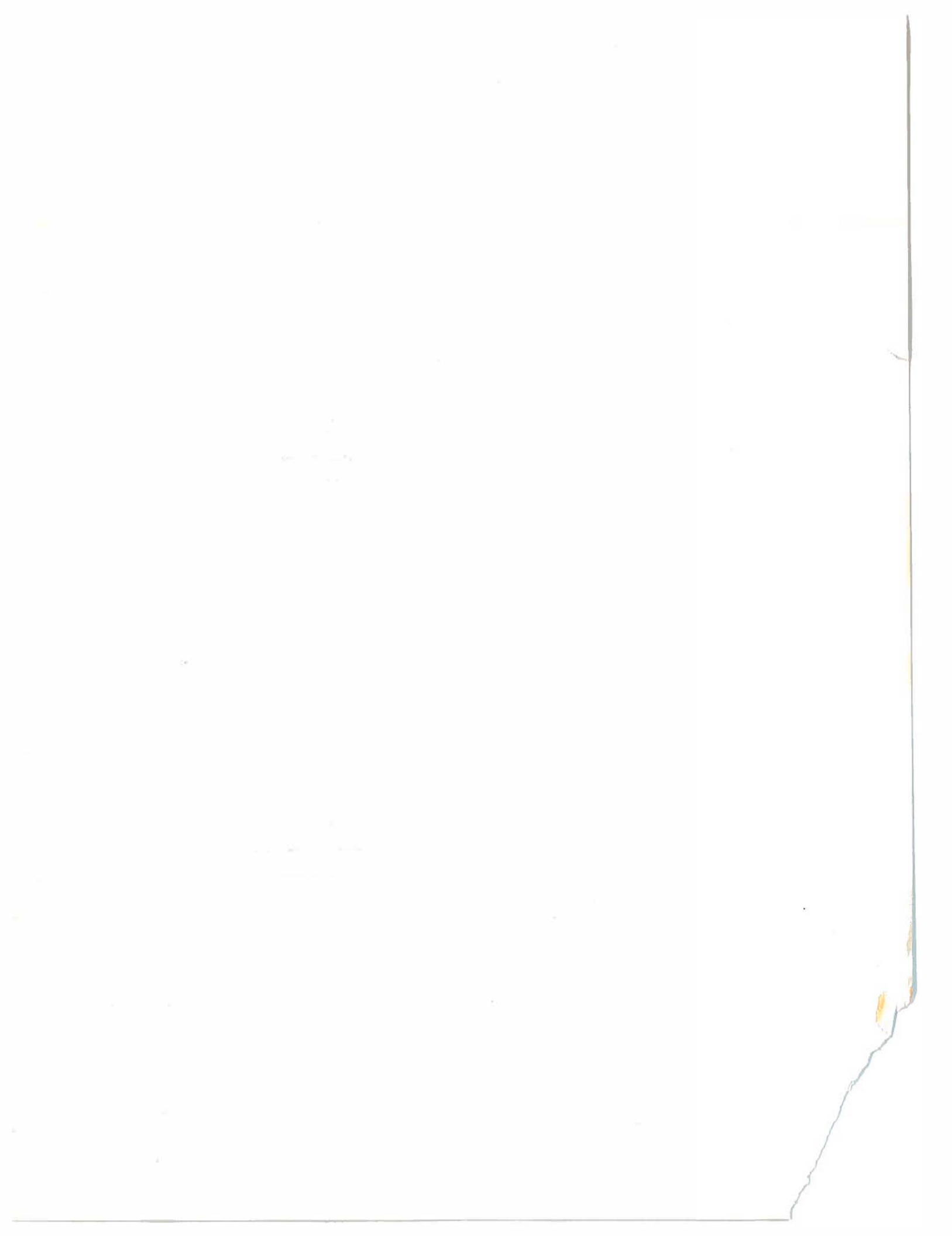


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INTRODUCTION

Research work at the Louisiana State University 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 1985 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 the main campus at 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 1985 are presented in this report representing the 77th Annual Report of the LSU Rice Research Station.

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 1985. Approximately 650 persons attended the annual Rice Research Station field day to view plots and participate in discussions of research findings. 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. Over 2000 people received services from the LSU Rice Research Station during 1985.

Projects at this station are conducted under the supervision of research workers from the Rice Station and also by cooperating personnel from certain campus departments. The following is a list of the Rice Research Station staff.

Joseph A. Musick	1/	Resident Director
D. Marlin Brandon		Rice Fertilization
Martin W. Brunson	2/	Fisheries
Charles R. Champagne		Rice Fertilization

1/ Resigned 7/25/85

2/ Resigned 1/31/85

Suzan S. Croughan ^{3/}	-----	Forage Crops Tissue Culture
Timothy P. Croughan	-----	Rice Tissue Culture
Raymond R. Dilly, Jr.	-----	Rice Physiology
Richard T. Dunand	-----	Rice Physiology
Wayne C. Faulk ^{4/}	-----	Farm Manager
Marty J. Frey ^{4/}	-----	Plant Pathology
Anthony J. Godeaux ^{5/}	-----	Rice Breeding
James L. Griffin	-----	Soybean Research
Donald E. Groth	-----	Plant Pathology
Robert J. Habetz	-----	Soybean Research
Farman Jodari	-----	Rice Breeding
William J. Leonards, Jr.	-----	Rice Fertilization
Kent S. McKenzie	-----	Rice Breeding
Gregory A. Meche	-----	Rice Physiology
Robert J. Michot	-----	Rice Insects
M. Fred Miller	-----	Rice Processing
Elaine M. Nowick	-----	Rice Genetics
Mona M. Pizzolatto	-----	Rice Tissue Culture
Sharon M. Rawls	-----	Rice Fertilization
Ronald P. Regan	-----	Soybean Research
John F. Robinson	-----	Rice Insects (USDA)
Gerardo R. Romero ^{6/}	-----	Beef Cattle
Donnie R. Stutes ^{7/}	-----	Station Maintenance
Richard W. Taylor ^{7/}	-----	Forage Research
George B. Trahan ^{8/}	-----	Rice Insects (USDA)
Douglas M. Walker ^{8/}	-----	Rice Fertilization
Ralph N. Webster	-----	Rice Insects (USDA)
Lawrence M. White, III	-----	Foundation Seed and Red Rice Research
T. Wayne White	-----	Beef Cattle
E. Allen Wilson	-----	Bird Control in Rice

^{3/} Appointed 4/15/85

^{4/} Appointed 1/1/85

^{5/} Resigned 9/30/85

^{6/} Appointed 3/1/85

^{7/} Resigned 2/15/85

^{8/} Transferred from Northeast Research Stn. 5/1/85

Cooperating personnel responsible for research projects at the Rice Station include the following campus staff.

John B. Baker-----Weed Control
Plant Pathology & Crop
Physiology Department
Louisiana State University

Gerard T. Berggren, Jr.-----Soybean Diseases
Plant Pathology & Crop
Physiology Department
Louisiana State University

Marc A. Cohn-----Red Rice Control
Plant Pathology & Crop
Physiology Department
Louisiana State University

Seth M. Dabney-----Wheat Research
Agronomy Department
Louisiana State University

Edward P. Dunigan-----Algae Control
Agronomy Department
Louisiana State University

Marcus M. Eichhorn, Jr.-----Forage Crops
Hill Farm Research Station

Thomas R. Harger-----Soybean Weed Control
Plant Pathology & Crop
Physiology Department
Louisiana State University

Steve A. Harrison-----Wheat Research
Agronomy Department
Louisiana State University

Bob G. Harville-----Wheat Research
Agronomy Department
Louisiana State University

F. Glen Hembry-----Beef Cattle
Animal Science Department
Louisiana State University

Bert J. Hoff-----Rice Genetics
Agronomy Department
Louisiana State University

Seth J. Johnson-----Insect Control
Entomology Department
Louisiana State University

Peter W. Jordan-----Disease Control
 Plant Pathology & Crop
 Physiology Department
 Louisiana State University

Lynn M. Kitchen-----Disease Control
 Plant Pathology & Crop
 Physiology Department
 Louisiana State University

Kenneth L. Koonce-----Experimental Statistics
 Experimental Statistics Department
 Louisiana State University

George D. Lindberg-----Rice Diseases
 Plant Pathology & Crop
 Physiology Department
 Louisiana State University

Edward C. McGawley-----Rice Diseases
 Plant Pathology & Crop
 Physiology Department
 Louisiana State University

Sharron S. Quisenberry-----Forage Insect Control
 Entomology Department
 Louisiana State University

Milton C. Rush-----Rice Diseases
 Plant Pathology & Crop
 Physiology Department
 Louisiana State University

Joseph E. Sedberry, Jr.-----Soil Chemistry
 Agronomy Department (Minor Elements)
 Louisiana State University

C. Michael Smith-----Rice Insects
 Entomology Department
 Louisiana State University

Thomas P. Zacharias-----Economics
 Agricultural Economics Department
 Louisiana State University

The Rice Station is especially indebted to Mr. H. F. Morris, Jr., Feed and Fertilizer Laboratory, for the chemical analysis of research samples. Dr. Kenneth L. Koonce, Department of Experimental Statistics, and his staff aided in the research program through their help in the planning and statistical analysis of research data.

RAINFALL DATA - 1985

Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year Total
1	1.11	.15	.62							.07		.45	-
2	.02	tr			.11						.65		-
3	.40							.65	1.40				-
4									1.16				-
5		.93	.18				.28		.05				-
6		.01							.15				-
7									.20				-
8								.48					-
9					.82				.25				-
10	.26								.42				-
11		1.65							1.15				-
12				.04		.07		.75		.15		1.17	-
13	.05							.04		.15		.76	-
14	.20		.01										-
15			.21		1.75		.02	.80		1.17			-
16			.30	.82				1.29		.88	1.05		-
17	1.38					.35	1.97						-
18						1.10					.15		-
19						2.25	.02						-
20			.03			.03				.08			-
21			1.99				1.40	.18		.12			-
22					1.86	.05			.05				-
23				.52	.20				.02	.17			-
24	.18	.95		.44	.97			.44		4.45			-
25	.02	1.65						.43		.01			-
26		.05		.32				.48					-
27	.20	.20	.01	.16				.44		3.95		.12	-
28	2.25		.05				.65			1.30		1.06	-
29										1.32			-
30	.06							.05	.53	1.89	1.55		-
31			.30				.28			1.42		.56	-
Mo.													
Total	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
1984	3.96	5.25	4.00	1.51	8.18	1.97	2.48	3.63	2.80	11.00	3.53	2.84	51.15

RICE BREEDING

DEVELOPING IMPROVED RICE VARIETIES FOR LOUISIANA^{1/}

(A Progress Report)

K.S. McKenzie, F. Jodari, A. Godeaux, R. Pollingue, H. Ledoux, and P. Brandt

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 1985.

SUMMARY 1985

Breeding activities have been intensified over the past 4 years, and the rice breeding program has more than doubled since its inception in 1982. Increases have occurred at all stages in the program including more crosses, more breeding lines, and two off-station yield trials. Development of improved high yield semidwarf varieties is still the primary thrust of the program. Seedling vigor, good quality, and disease resistance are important traits to be incorporated into these improved varieties and screening for such characters is continuing.

In 1985, three hurricanes hit Louisiana. Some were particularly damaging to the breeding program. Lodging was severe in the very early preliminary yield test and the midseason lines in the Uniform Nursery and Commercial Variety Tests. This confounded accurate yield and quality evaluations. Some long- and medium-grain semidwarf lines in the advance testing phase performed very well and are scheduled for further seed increase and advanced multi-location testing.

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

GERMPLASM

New sources of genetic variability are essential to the rice breeding program to provide the plant characters desired in future rice cultivars. Plant materials which have desirable agronomic and quality characteristics are continually being acquired, evaluated, and incorporated into the Louisiana rice breeding program. This germplasm is supplied from several different sources. At the Rice Research Station germplasm is being supplied by the cooperating pathology, entomology, and tissue culture projects. Cooperating rice breeding and genetics programs in other rice producing states have also cooperated in germplasm exchanges with this breeding program. Material introduced from outside the U.S. are processed by the pathologists in accordance with USDA-APHIS guidelines. The 1985 preliminary report of the Rice Research Station (RRS) pathology project discusses the new rice introduction made in 1985.

NEW CROSSES

In 1985, approximately 230 new crosses were made in the greenhouse. A large portion of the parents included disease and insect resistant germplasm developed by the breeding program and from foreign plant introductions. The breeding nursery contained 141 F_1 transplanted populations which included several BC F_1 populations. The 1985 nursery contained 178 F_2 populations, 21,834 progeny rows (compared to 11,275 progeny rows in 1984),² 185 germplasm seed increase plots, and 288 four x 6 ft water-seeded advance selection plots. Over 20,000 panicle and row selections were made from the nursery in 1985. Amylose content and alkali spreading scores on selected breeding lines are being analyzed by the Regional Rice Quality Laboratory in Beaumont, TX.

MUTATION BREEDING

Induced mutation as a tool in rice breeding has had notable success in California on developing adapted semidwarf lines and even new cultivars. Mutation breeding research was initiated in this project in 1982 with the goal of recovering some potentially useful induced mutants in some of the adapted rice cultivars grown in Louisiana. Cobalt 60 has been used to induce semidwarf and/or early maturing mutants of 'Mars', 'Saturn', 'Nato', 'Labelle', 'Tebonnet', 'Lebonnet', 'Della', 'Tetep', and 'WC 1711'. Many of these mutants have been recycled as parents in the crossing program. The most promising have undergone multilocation yield testing. Some lines will continue to be evaluated in 1986 and some material will be registered and released as germplasm. Of particular interest are the short and early mutants of the blast and sheath blight resistant Vietnamese variety Tetep, 'PI500071', and 'PI500072'. These lines may serve as improved disease resistant germplasm sources. WC 1711 mutants offer some semidwarf sources of water weevil tolerance for varietal improvement. Finally, a semidwarf mutant of the aromatic variety Della did show some yield advantage over Della in cooperative tests in Texas, Arkansas, and Mississippi. Lodging was very severe in Louisiana due to Hurricane Danny and the semidwarf Della mutant yielded similar to Della. More detailed N rate testing of this mutant and Della are scheduled for 1986.

SEEDLING VIGOR

Cool temperature seedling vigor has long been recognized as an important characteristic in temperate rice growing areas. Intensive selection for

seedling vigor has been an important integral part of the California rice breeding programs and their rice varieties show good levels of cool temperature seedling vigor. Improvements in cool temperature seedling vigor of Louisiana rice varieties, especially long-grains which originate from tropical germplasm, would be very desirable. Cool temperatures are often encountered during early spring planting delaying or reducing emergence and stand establishment. The new lodging-resistant semidwarf types often have short mesocotyls and reduced seedling height making stand establishment difficult. Vigorous semidwarf lines with good cool temperature seedling vigor will need to be developed for Louisiana.

Seedling vigor screening is being incorporated into the selection process of the LSU rice breeding program. Cool temperature laboratory seedling vigor tests have been conducted on all advancing breeding lines and used in selection and advancement decisions. Cold tolerant parents are being utilized in the crossing program to enhance the levels of seedling vigor. Laboratory seedling vigor screening of selections from the breeding program is beginning to show advances are being made especially in the newest long-grain semidwarf lines. Seedling vigor ratings are being made on the water-seeded and drill-seeded experiments. Several medium-grain semidwarf lines have shown good levels of seedling vigor in water-seeded tests. Seedling vigor improvements will not be easily realized in adapted disease-resistant lines, however, these screening efforts are identifying lines with satisfactory or improved levels of seedling vigor for varietal development.

COOPERATIVE UNIFORM REGIONAL RICE NURSERY

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 1984 nursery included material from Arkansas, California, Louisiana, Texas, and a number of cultivars from foreign countries. Information on performance characteristics is compiled and stored in the LSU Rice Data Bank by the LSU Department of Experimental Statistics.

MATERIALS AND METHODS

Seven test groups (I to VII) organized by maturity were evaluated in water-seeded experiments at the Rice Research Station in 1985. Fifty-two of the 184 entries were from the LSU rice breeding program. All tests were conducted in a randomized complete block design, with four replications in groups I to IV and two replications in groups V to VII. Fertilizer was applied and incorporated pre-flood at a rate of 120-60-60 lb/A total NPK. Experimental plots were 53 inches wide and 16 feet long. Treated, presoaked, germinating seed was hand broadcast into the water and all plots were seeded at 150 lb/A. The plots were drained to allow seedlings to anchor and a shallow permanent flood applied until harvest. Seeding dates were as follows: groups I-VI, April 11; group VII, April 12. Visual subjective seedling vigor ratings were made as the rice emerged through the water and other agronomic data collected during the growing season. Propanil, Basagran®, and carbofuran were applied at recommended rates for weed and water weevil control, respectively. At maturity

the ends of the plots were trimmed to 12 feet and the plot center (29 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.

RESULTS AND DISCUSSION

Weather conditions were good while water-seeding and good seed distribution and plot stands were obtained. Seedling vigor differences in entries were observed. Hurricane Danny struck the breeding nursery prior to harvest of groups IV and VII. The lodging in those groups was severe, yields were reduced, and CVs for yield were high (>10%). Nanjing 11 produced the highest yield of 8,440 lb/A. Several semidwarf long- and medium-grain entries from Louisiana gave respectable performances.

Table 1 contains the mean values for the very-early maturing entries (group I) of the advanced test. Average yield for these entries was 6,779 lb/A. Entries 2, 5, 8, and 11 were experimental lines from Louisiana and averaged 6,487 lb/A and 65% head rice. 'Tebonnet' performed well in this test. Entry 12 from Texas yielded well but the head rice was a little low.

Table 2 contains results from group II. Average yield of these early maturing entries was 7,082 lb/A. Entries 22, 25, 28, and 31 were Louisiana entries and averaged 7,194 lb/A and 61% head rice.

Group III results are presented in Table 3. Average yield for these early maturing entries was 7,173 lb/A. Louisiana entries were 42, 45, 48, and 51 and had an average yield of 7,426 lb/A and 63% head rice. Entries 42, 45, and 51 yielded well and will be tested extensively in 1986.

Group IV results are summarized in Table 4. Average yield for this group was 6,265 lb/A. Entries from Louisiana included numbers 62, 65, 68, 71, and 74. Average yield for the Louisiana entries was 6,216 lb/A and 59% head rice. Hurricane Danny caused severe lodging and probably contributed to the reduced percent head rice yield on some entries.

Group V contained the very-early and early maturing preliminary entries and the results are summarized in Table 5. Average yield of this group was 7,139 lb/A with a very large range in yield performance. Louisiana entries included numbers 82, 85, 88, 91, 94, 97, 100, 103, 106, 109, 112, and 115. The Louisiana experimentals averaged 7,438 lb/A and 62% head rice. The Chinese variety Nanjing 11 performed very well again in 1985 in yield and seedling vigor, however, the milling characteristics and other grain quality factors make it unacceptable to the U.S. market. Entry 109 is a very early maturing mutant of Saturn and lodged before maturity and a reliable yield estimate was not obtained.

Table 6 contains the performance summary for group VI. Average yield of these lines was 6,440 lb/A. Entries from Louisiana included numbers 122, 125, 128, 131, 134, 137, 140, 143, 146, 149, 152, and 155. Average yields of the experimental entries from Louisiana was 6,334 lb/A and 59% head rice. 'Brazos' gave the highest yield but lodged. Saturn lodged early and a reliable yield estimate was not obtained.

TABLE 1. AGRONOMIC PERFORMANCE OF 1985 UNIFORM RICE NURSERY, GROUP I. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
12	L	6	78	33	0	7763	A	57-69
TEBONNET	L	5	75	48	0	7630	AB	63-71
9	L	6	76	33	0	7432	ABC	62-71
1	M	4	80	46	0	7345	ABC	65-69
2	L	6	75	33	0	7273	ABC	63-70
7	L	4	75	46	0	7147	ABCD	60-66
11	M	3	76	34	0	6993	BCDE	65-69
SKYBONNET	L	5	79	46	0	6947	BCDE	59-69
4	L	6	76	48	0	6736	CDE	57-68
10	L	4	74	45	0	6698	CDE	62-67
BOND	L	6	74	43	0	6466	DEF	61-69
8	L	4	73	34	0	6289	EF	63-71
6	L	8	81	36	0	6280	EF	55-70
3	L	4	72	39	0	6267	EF	64-71
LABELLE	L	6	74	47	0	5806	FG	64-70
5	L	6	75	33	8	5394	G	67-72
C.V.		12.1	1.3	4.0	-	6.7		4.2-1.5

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 1985 UNIFORM RICE NURSERY, GROUP II. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
26	L	6	80	35	0	7862	A	62-71
MARS	M	3	83	45	10	7804	A	67-70
28	L	5	79	33	0	7692	A	61-71
30	M	5	81	44	10	7627	AB	69-72
21	M	4	82	41	8	7524	ABC	67-70
22	M	4	81	37	3	7382	ABC	65-69
24	M	4	81	42	10	7248	ABCD	67-70
27	S	4	82	44	13	7030	ABCD	66-70
REXMONT	L	5	78	33	0	6974	ABCD	59-69
31	L	6	79	35	0	6964	ABCD	60-71
29	L	8	83	37	0	6775	BCD	52-71
23	L	7	80	33	0	6674	CDE	66-72
25	L	4	82	43	15	6431	DE	59-71
LEAH	L	3	83	42	0	6424	DE	51-71
PECOS	M	4	78	42	83	5827	E	66-70
C.V.		12.3	1.0	3.3	--	7.3		4.5-1.0

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 1985 UNIFORM RICE NURSERY, GROUP III. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
51	L	4	80	34	0	7908	A	61-70
NEWBONNET	L	5	85	41	0	7894	A	62-69
45	L	5	82	33	0	7672	AB	62-71
50	L	4	82	45	20	7510	ABC	58-68
GULFMONT	L	5	82	34	0	7363	ABCD	65-71
43	L	7	83	34	0	7334	ABCD	64-72
41	L	3	81	45	40	7332	ABCD	62-69
42	L	5	79	32	0	7092	BCDE	65-71
TORO-2	L	3	82	40	20	7071	BCDE	66-73
LEMONT	L	5	84	34	0	7069	BCDE	63-71
48	L	4	81	31	0	7032	BCDE	65-72
52	L	5	79	34	0	6894	BCDE	62-72
44	L	6	87	43	8	6888	BCDE	60-68
BELLEFONT	L	6	81	31	0	6782	CDE	66-72
49	L	6	80	33	0	6595	DE	68-72
47	L	5	92	36	0	6309	E	54-70
C.V.		13.7	1.0	3.9	--	6.6		6.8-1.2

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 1985 UNIFORM RICE NURSERY, GROUP IV. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
68	L	5	82	32	20	7115	A	64-72
74	L	6	92	35	23	6660	AB	65-72
69	L	6	81	32	0	6581	ABC	46-72
71	L	6	87	35	3	6510	ABC	63-75
66	L	5	80	33	0	6298	ABC	43-71
61	L	4	92	35	15	6115	ABC	49-72
RICO I	M	4	84	44	78	6036	ABC	67-72
63	L	6	81	34	68	5939	ABCD	52-72
67	L	6	91	35	0	5786	ABCDE	50-71
65	L	4	80	36	80	5436	BCDE	52-71
62	L	6	81	34	40	5358	BCDEF	51-72
75	L	6	80	36	48	5126	CDEF	59-72
70	L	3	87	43	85	4505	DEFG	62-70
64	L	3	87	45	88	4362	EFG	59-70
STARBONNET	L	4	95	46	83	3945	FG	65-70
73	L	4	88	44	90	3261	G	55-71
C.V.		11.3	1.0	4.7	--	16.0		3.4-1.6

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 1985 UNIFORM RICE NURSERY, GROUP V. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
NANJING 11	M	2	82	40	35	8440	A	47-68
90	L	6	76	44	5	8122	AB	53-70
115	M	3	80	41	5	8111	AB	65-69
97	M	3	82	39	0	7907	ABC	67-71
96	L	5	82	46	15	7837	ABC	55-70
S-201	S	4	82	43	55	7822	ABC	68-72
94	M	3	78	39	10	7802	ABC	64-69
92	L	6	79	37	0	7719	ABC	63-72
100	M	4	76	37	5	7695	ABCD	65-70
108	L	6	80	43	20	7629	ABCDE	58-70
114	L	6	80	43	0	7613	ABCDE	55-64
102	L	5	78	43	0	7605	ABCDE	59-72
98	L	6	83	38	0	7515	ABCDE	64-72
82	M	3	80	42	15	7513	ABCDE	63-71
85	L	7	77	38	0	7499	ABCDE	62-72
103	L	3	76	38	0	7454	ABCDE	64-69
84	L	5	79	41	0	7287	ABCDE	58-68
101	L	6	81	43	0	7245	ABCDE	59-70
91	L	5	80	33	0	7236	ABCDE	59-71
M-201	M	6	72	35	10	7121	ABCDE	69-72
111	L	4	77	43	5	7112	ABCDE	52-72
106	L	3	76	40	5	7039	ABCDEFG	63-70
104	L	7	82	33	0	7028	ABCDEFG	64-72
81	L	4	80	44	0	7025	ABCDEFG	57-71
99	L	5	76	47	10	6984	ABCDEFG	61-68
105	M	4	75	41	10	6968	ABCDEFG	68-71
88	L	7	81	37	0	6959	ABCDEFG	50-71
89	L	7	81	36	0	6946	ABCDEFG	62-71
L-202	L	3	74	39	0	6942	ABCDEFG	59-71
86	L	5	74	44	0	6857	BCDEFG	65-73
87	L	5	79	44	5	6782	BCDEFG	53-70
112	L	4	79	34	0	6605	CDEFG	49-70
83	L	7	84	33	0	6514	CDEFG	62-70
113	L	5	73	42	0	6411	CDEFGH	59-70

CONTINUED.

TABLE 5. AGRONOMIC PERFORMANCE OF 1985 UNIFORM RICE NURSERY, GROUP V. RICE RESEARCH STATION, CROWLEY, LA. CONTINUED.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
93	M	4	81	44	50	6216	DEFGH	67-71
107	L	9	71	34	0	6147	EFGH	61-70
116	L	7	82	34	0	6086	FGH	64-73
95	L	8	83	41	0	5608	GH	65-70
110	L	9	76	37	0	5053	H	53-71
109	M	5	73	47	60	-		69-71
C.V.		13.4	1.0	3.4	--	8.5		3.1-2.6

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 1985 UNIFORM RICE NURSERY, GROUP VI. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
BRAZOS	M	5	82	43	75	7749	A	66-72
154	S	6	82	41	10	7744	A	67-70
127	L	5	80	36	0	7690	AB	49-72
121	L	5	84	44	40	7479	ABC	57-70
147	L	5	81	32	0	7401	ABCD	61-73
132	L	6	81	32	0	7281	ABCD	63-72
140	L	5	81	36	0	6964	ABCDE	57-72
148	L	4	85	44	0	6962	ABCDE	62-73
122	M	2	83	40	20	6957	ABCDE	68-71
142	L	4	78	40	0	6920	ABCDE	59-72
135	L	7	82	35	0	6883	ABCDE	63-72
152	L	5	81	33	0	6794	ABCDE	66-71
144	L	5	73	37	0	6738	ABCDE	63-70
128	L	5	82	36	0	6699	ABCDE	52-71
146	L	5	82	36	0	6592	ABCDE	59-71
150	L	7	80	33	0	6588	ABCDE	63-71
125	M	3	81	35	5	6516	ABCDE	68-72
126	L	7	81	31	0	6450	ABCDE	61-72
155	L	4	82	42	0	6441	ABCDE	50-72
124	L	6	82	40	20	6439	ABCDE	53-71
145	L	5	81	37	0	6431	ABCDE	50-74
123	L	6	77	34	0	6399	ABCDE	61-72
138	L	7	82	33	0	6372	ABCDE	62-71
131	L	5	76	32	0	6369	ABCDE	58-72
136	L	4	82	44	5	6320	ABCDE	58-70
133	L	6	76	41	0	6294	ABCDE	59-71
139	L	4	84	43	10	6241	ABCDE	64-73
149	L	5	82	29	0	6208	BCDEF	60-72
137	L	5	78	34	0	6158	BCDEF	56-71
NEWREX	L	5	77	43	25	6009	CDEF	54-70
130	L	5	79	44	5	5956	CDEF	60-70

CONTINUED.

TABLE 6. AGRONOMIC PERFORMANCE OF 1985 UNIFORM RICE NURSERY, GROUP VI. RICE RESEARCH STATION, CROWLEY, LA. CONTINUED.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
134	L	5	87	36	0	5932	DEFG	61-69
153	L	9	79	31	0	5613	EFG	61-72
141	L	8	80	29	0	5488	EFG	63-71
156	L	6	73	30	0	5448	EFG	51-72
NATO	M	3	83	49	80	5107	FG	71-72
143	L	6	82	29	0	4377	GH	57-72
129	L	9	84	32	0	3308	H	63-72
SATURN	M	3	84	50	90	-		67-72
C.V.		14.1	1.0	3.5	--	9.2		6.8-1.0

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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.

Group VII contained early and midseason preliminary entries. The average yield for this group was 5,632 lb/A and showed a very wide range in yield performance (Table 7). Yields were variable and lodging was high as a result of Hurricane Danny. Louisiana experimental entries included 162, 165, 168, 171, 174, 177, 180, 183, 186, 189, 195 and had an average yield of 3,237 lb/A and 56% head rice. 'Gui Chow' outyielded all other entries but showed low head rice yields typical of many foreign introductions. Entries 168, 171, 174, 177, and 180 are short stature induced mutants of Lebonnet. Entry 182 is a short stature plant regenerated from mutants of the water weevil tolerant short grain WC 1711. Entry 186 is a semidwarf mutant of the aromatic variety Della.

COMMERCIAL VARIETY TESTS

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.

MATERIALS AND METHODS

Thirty-four entries were evaluated in the 1985 commercial variety test at the Rice Research Station (RRS), Crowley, the Northeast Research Station (NRS), St. Joseph, LA, and the Macon Ridge Research Station (MR). Testing at the NRS was conducted by Dr. M.P. Westcott and at MR by Dr. M. Milam. The entries 'Bellevue', 84AS2055, 85AS2056, 85AS3057, and 83AS3053 are entries from the Alexandria Seed Company, Alexandria, LA, and RAX2415, RAX2411, and RAX2413 are F₁ hybrids from the Ring-Around Seed Company, Plainview, TX. Entries were divided into three maturity groups (very early, early, and midseason) and managed as separate experiments. The experimental design was a randomized complete block with four replications. Entries were drill-seeded at 100 lb/A at all locations. The hybrids were 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 3, 1985, flushed to initiate germination, and a permanent flood was applied as soon as seedlings were tall enough for a shallow flood. Propanil and carbofuran 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 a small milling sample taken. The four center rows were taken at harvest and yields estimated based on the total harvested area. Harvested samples were dried to approximately 12% moisture in a small sample drier. All yields are reported at 12% moisture and are means of four replications.

At NRS, the test was planted May 6, 1985. Ninety lb N/A was applied pre flood. Herbicide applications included Ordram® (3 lb/A) preplant incorporated, and a propanil (3 qt/A) Bolero® (3 pt/A) tank mix. A second application of propanil (3 qt/A) was applied June 4, 1985. The entire plot (6.25 x 25') was harvested at maturity, yield determined, and reported as means of four replications at 12% moisture. At MR, the test was planted on April 19, 1985. 0-60-60 lb NPK/A was preplant incorporated and 90 lb/A of N was applied pre flood. Herbicides included a tank mix of propanil (3 qt/A) and Bolero® (3

TABLE 7. AGRONOMIC PERFORMANCE OF 1985 UNIFORM RICE NURSERY, GROUP VII. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
GUI CHOW	M	4	90	42	85	8317	A	59-70
195	S	4	93	41	40	7010	AB	68-71
182	M	2	82	44	90	6951	AB	59-69
168	L	7	85	33	20	6933	AB	51-71
176	L	5	91	47	70	6869	AB	57-69
192	S	4	93	42	45	6696	AB	67-71
172	L	5	82	34	0	6615	ABC	52-71
197	L	3	80	40	85	6559	ABC	54-69
187	L	5	80	37	40	6538	ABC	57-72
169	L	6	79	35	15	6506	ABC	59-70
167	L	5	88	41	85	6354	ABC	63-70
184	L	5	84	36	80	6323	ABC	61-71
181	L	5	81	35	60	6136	ABC	59-72
196	L	5	76	36	80	6118	ABC	53-71
163	L	5	81	31	30	6025	ABCD	42-72
191	M	3	81	42	90	6011	ABCDE	63-70
164	L	6	91	37	5	5994	ABCDE	50-71
178	L	6	79	34	10	5985	ABCDE	57-71
165	L	6	90	37	0	5871	ABCDEF	61-69
166	L	7	83	39	90	5775	ABCDEF	61-68
175	L	5	81	35	40	5755	ABCDEF	55-71
179	M	3	83	45	60	5738	ABCDEF	66-69
173	L	6	91	36	0	5613	BCDEF	47-71
190	L	8	79	38	90	5582	BCDEF	34-70
193	L	7	81	31	0	5469	BCDEF	51-71
170	L	4	84	42	70	5372	BCDEF	58-70
161	L	6	91	36	15	5145	BCDEF	51-71
180	L	6	86	40	85	5054	BCDEF	41-70
174	L	5	85	41	90	4972	BCDEF	51-64
177	L	4	89	40	85	4959	BCDEF	62-70
162	L	6	86	39	80	4924	BCDEF	64-72
171	L	5	81	36	30	4892	BCDEF	42-72

CONTINUED.

TABLE 7. AGRONOMIC PERFORMANCE OF 1985 UNIFORM RICE NURSERY, GROUP VII. RICE RESEARCH STATION, CROWLEY, LA. CONTINUED.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
NORTAI	M	6	92	44	75	4660	BCDEF	70-72
188	L	3	85	47	85	4558	BCDEF	58-71
183	L	5	82	34	65	4455	BCDEF	49-71
194	L	4	81	45	80	4389	BCDEF	54-71
185	L	4	87	42	80	4040	CDEF	65-71
186	L	7	86	43	90	3428	DEF	57-70
DELLA	L	4	85	49	90	3385	EF	54-70
BONNET 73	L	4	91	47	85	3349	F	56-67
C.V.		14.7	1.3	3.9	--	19.0		6.1-2.7

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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.

pt/A) applied preflood. Furadan® was applied for water weevil control. The plots (5 x 25') were harvested at maturity and yield determined and reported as means of four replications at 12% moisture.

RESULTS AND DISCUSSION

Performance results for the 1985 commercial variety test are presented for the RRS, NRS, and MR locations in Tables 8 through 16. An overall analysis was also performed and is presented in Tables 17 through 19.

Group V (Table 10) at RRS was harvested after Hurricane Danny and lodging was severe, especially on the earlier maturing entries. Significant statistical differences among test entries between locations were observed. Rico 1 gave high yields at all locations as did Gui Chow. The Chinese F₁ hybrids from Ring-Around Seed Company did not show the yield advantages that had been seen on previous entries.

ADVANCED YIELD TESTS

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.

In 1985, the Advanced Yield tests were conducted at three locations in Louisiana in cooperation with commercial growers and the RRS fertilizer and entomology projects. Sixteen early maturing entries were tested at the RRS, Errol Lounsberry farm near Lake Arthur, and A.W. Bollich farm near Cheneyville. Experimental design was a randomized complete block with four replications. Plots at Lake Arthur and Cheneyville were 7 x 25' and 4.7 x 22' at the RRS. Rice was water-seeded (150 lb/A) at Lake Arthur, broadcast (150 lb/A), and drill-seeded (100 lb/A) at Cheneyville and the RRS, respectively. Propanil and Furadan® were used for weed and water weevil control at all locations. Fertilization included 120-60-60 lb/A NPK preplant preflood at Lake Arthur, 120 lb/A N preflood at Cheneyville, and 60-60-60 lb/A NPK preplant with 100 lb/A N preflood at the RRS. A second crop was grown at Lake Arthur. Sixty lb/A N was applied to the plots before reflooding. Planting date for Lake Arthur, Cheneyville, and the RRS were March 21, April 17, and April 30, respectively.

RESULTS AND DISCUSSION

Agronomic performance of the 1985 Advanced Yield tests are shown in Tables 20 through 26. Harvest at the RRS was after Hurricane Danny, and Mars, 211, and 212 lodged severely and no yield estimates were obtained. Yields at Lake Arthur were very good and the additional second crop yields pushed total yield on some entries over 10,000 lb/A (Tables 21 to 23). Experimental semidwarf entries 201, 203, and 213 performed particularly well and are scheduled for further testing in 1986 (Table 24).

Yields at Cheneyville were reduced due to blackbird feeding on the early heading entries, especially entries 213, and 201 and 203 to a lesser extent

TABLE 8. AGRONOMIC PERFORMANCE OF 1985 COMMERCIAL VARIETY TESTS, GROUP VIII. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
L-202	L	83	36	0	6636	A	59-67
TEBONNET	L	81	48	3	6569	AB	66-69
306	L	85	36	0	6327	ABC	62-69
SKYBONNET	L	84	45	3	6308	ABC	64-69
BOND	L	81	42	5	6126	BC	61-67
85AS3057	M	84	48	0	5912	CD	67-69
LABELLE	L	80	47	13	5555	D	68-70
84AS2055	L	80	51	38	5065	E	65-69
85AS2056	L	75	44	3	4384	F	66-70
C.V.		1	2	---	5		1.7-1.0

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

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

TABLE 9. AGRONOMIC PERFORMANCE OF 1985 COMMERCIAL VARIETY TESTS, GROUP IX. RICE
RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
RICO 1	M	92	43	25	7792	A	65-70
MARS	M	90	44	43	7736	A	66-70
314	L	88	35	0	7658	AB	58-71
313	L	89	32	0	7209	ABC	62-68
LEMONT	L	91	36	0	7204	ABC	58-71
324	M	89	37	0	7185	ABC	61-68
PECOS	M	87	43	75	7184	ABC	63-69
BRAZOS	M	89	45	60	7115	ABC	64-70
315	L	88	32	0	6918	BC	54-71
GULFMONT	L	88	36	0	6908	BC	55-70
TORO-2	L	90	41	0	6829	C	55-71
LEAH	L	92	42	0	6628	CD	46-70
83AS3053	M	90	46	53	6527	CD	64-70
REXMONT	L	84	32	15	6487	CD	52-69
LEBONNET	L	87	48	55	6065	D	43-71
SATURN	-	93	51	90	-		67-70
C.V.		0.7	3.4	--	6.9		1.7-1.0

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

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

TABLE 10. AGRONOMIC PERFORMANCE OF 1985 COMMERCIAL VARIETY TESTS, GROUP X. RICE
RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
GUI CHOW	M	99	40	88	9233	A	60-69
RAX2415	L	90	41	78	7394	B	28-69
RAX2411	L	88	42	88	6725	BC	36-69
RAX2413	L	90	42	65	6529	BC	30-70
NEWBONNET	L	94	39	68	6370	C	63-71
BELLEVUE	L	100	51	25	5861	C	63-71
330	L	102	39	0	5712	C	67-72
329	L	98	37	0	5669	CD	60-72
STARBONNET	L	105	47	65	4596	D	65-70
C.V.		1.2	6.9	--	10.2		1.7-1.0

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

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

TABLE 11. AGRONOMIC PERFORMANCE OF 1985 COMMERCIAL VARIETY TESTS, GROUP VIII.
ST. JOSEPH, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***
TEBONNET	L	2	86	50	0	7286	A
L-202	L	2	85	37	0	7051	A
85AS2056	L	2	80	41	0	6730	AB
85AS3057	M	2	86	49	0	6146	ABC
BOND	L	4	84	41	0	6061	ABC
84AS2055	L	2	86	53	0	5930	ABC
SKYBONNET	L	2	87	44	0	5910	ABC
306	L	7	88	34	0	5419	BC
LABELLE	L	3	85	50	0	5280	C
C.V.		17.3	2	6.5	-	11.8	

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 12. AGRONOMIC PERFORMANCE OF 1985 COMMERCIAL VARIETY TESTS, GROUP IX.
ST. JOSEPH, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***
RICO 1	M	5	88	44	0	8773	A
MARS	M	2	88	44	0	8102	A
324	M	3	88	38	0	7825	AB
GULEMONT	L	4	87	36	0	7447	ABC
PECOS	M	4	85	43	40	7382	ABC
LEBONNET	L	4	87	50	0	7371	ABC
LEMONT	L	4	89	37	0	7304	ABC
315	L	5	87	36	0	7092	ABCD
83AS3053	M	4	88	50	8	7028	ABCD
REXMONT	L	6	85	36	0	6894	ABCD
BRAZOS	M	3	86	49	48	6814	ABCD
TORO-2	L	4	87	44	0	5975	BCD
313	L	5	88	34	0	5502	CD
LEAH	L	3	88	42	0	5271	D
314	L	4	89	34	0	5238	D
SATURN	M	2	88	55	90	5133	D
C.V.		14.9	1	7.8	--	17.9	

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 13. AGRONOMIC PERFORMANCE OF 1985 COMMERICAL VARIETY TESTS, GROUP X.
ST. JOSEPH, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***
NEWBONNET	L	3	91	47	0	9552	A
RAX2411	L	4	87	45	60	9314	AB
RAX2415	L	6	89	44	48	9028	AB
RAX2413	L	6	89	44	30	8870	AB
GUI CHOW	M	4	93	46	18	8548	AB
330	L	4	93	39	0	7913	BC
329	L	4	92	37	0	7034	C
BELLEVUE	L	2	93	56	0	6995	C
STARBONNET	L	2	95	52	0	6581	C

C.V. 17.7 1.1 4.1 -- 11

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 14. AGRONOMIC PERFORMANCE OF 1985 COMMERCIAL VARIETY TESTS, GROUP VIII. MACON RIDGE, LA.

1985 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **
TEBONNET	L	88	38	0	7128	A
L-202	L	85	28	0	6802	AB
BOND	L	86	34	0	6616	AB
84AS2055	L	86	38	0	6588	AB
SKYBONNET	L	90	36	0	6310	BC
306	L	92	31	0	6043	BC
LABELLE	L	86	36	0	5687	CD
85AS3057	M	84	36	0	5654	CD
85AS2056	L	81	33	3	5207	D
C.V.		2	3.2	-	7.7	

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

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

TABLE 15. AGRONOMIC PERFORMANCE OF 1985 COMMERCIAL VARIETY TESTS, GROUP IX. MACON RIDGE, LA.

1985 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **
RICO 1	M	93	34	0	8958	A
314	L	93	28	0	7276	B
MARS	M	91	35	0	7217	BC
LEAH	L	91	31	0	7075	BCD
BRAZOS	M	89	34	0	6699	BCDE
83AS3053	M	92	39	0	6633	BCDE
LEMONT	L	97	30	0	6608	BCDE
SATURN	L	91	41	38	6482	CDE
324	M	90	29	0	6430	DE
315	L	94	29	0	6417	DE
TORO-2	L	88	33	0	6391	DE
GULFMONT	L	97	30	0	6251	E
PECOS	M	88	30	0	6087	E
313	L	90	29	0	6044	E
LEBONNET	L	91	37	0	5921	E
REXMONT	-	93	29	0	5130	F
C.V.		1.6	5.2	--	7.1	

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

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

TABLE 16. AGRONOMIC PERFORMANCE OF 1985 COMMERICAL VARIETY TESTS,
GROUP X. MACON RIDGE, LA.

1985 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **
GUI CHOW	M	103	35	0	6950	A
NEWBONNET	L	95	35	0	5994	B
RAX2415	L	92	32	0	5841	B
RAX2411	L	90	33	0	5715	B
RAX2413	L	92	31	0	5695	B
BELLEVUE	L	98	40	0	5488	B
330	L	96	30	0	5416	B
329	L	97	31	0	5225	B
STARBONNET	L	103	39	0	5114	B
C.V.		2.3	2.8	-	10.3	

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

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

TABLE 17. AGRONOMIC PERFORMANCE OF 1985 COMMERCIAL VARIETY TESTS, GROUP VIII.
THREE LOCATIONS IN LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***
TEBONNET	L	2	85	45	1	6968	A
L-202	L	2	84	33	0	6809	A
BOND	L	4	84	39	2	6286	B
SKYBONNET	L	2	87	42	1	6200	B
306	L	7	88	34	0	5976	BC
85AS3057	M	2	85	44	0	5882	BC
84AS2055	L	2	84	47	13	5854	BC
LABELLE	L	3	84	44	4	5528	CD
85AS2056	L	2	79	39	2	5323	D
C.V.		17.3	1.7	4.5	--	8.3	

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 18. AGRONOMIC PERFORMANCE OF 1985 COMMERCIAL VARIETY TESTS, GROUP IX.
THREE LOCATIONS IN LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***
RICO 1	M	5	91	40	8	8507	A
MARS	M	2	89	41	14	7685	B
324	M	3	89	34	0	7146	BC
LEMONT	L	4	92	34	0	7039	BCD
PECOS	M	4	87	39	38	6884	CDE
BRAZOS	M	3	88	43	36	6876	CDE
GULFMONT	L	4	90	34	0	6868	CDE
315	L	5	90	33	0	6809	CDE
83AS3053	M	4	90	45	20	6730	CDE
314	L	4	90	32	0	6724	CDE
LEBONNET	L	4	88	45	18	6452	CDEF
TORO-2	L	4	89	39	0	6398	CDEF
LEAH	L	3	90	38	0	6325	DEF
313	L	5	89	32	0	6251	DEF
REXMONT	L	6	87	32	5	6170	EF
SATURN	M	2	91	49	73	5807	F
C.V.		14.9	1.1	5.9	--	11.9	

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 19. AGRONOMIC PERFORMANCE OF 1985 COMMERCIAL VARIETY TESTS, GROUP X.
THREE LOCATIONS IN LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***
GUI CHOW	M	4	98	40	35	8244	A
RAX2415	L	6	90	39	42	7421	B
NEWBONNET	L	3	93	40	23	7305	B
RAX2411	L	4	88	40	49	7251	B
RAX2413	L	6	90	39	32	7031	B
330	L	4	97	36	0	6347	C
BELLEVUE	L	2	97	49	8	6114	C
329	L	4	95	35	0	5976	CD
STARBONNET	L	2	101	46	22	5430	D
C.V.		17.7	1.6	5.1	--	10.7	

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 20. AGRONOMIC PERFORMANCE OF 1985 ADVANCED YIELD TESTS, GROUP XVIII. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
NEWBONNET	L	4	86	47	0	7410	A	65-69
201	L	7	84	37	0	6963	AB	65-71
203	L	6	82	37	0	6770	ABC	66-71
LEMONT	L	6	85	38	0	6708	ABC	66-72
213	M	3	83	41	23	6635	ABC	67-71
207	L	6	82	40	5	6624	ABC	62-69
208	L	6	84	41	0	6584	ABC	62-69
205	L	6	82	37	0	6441	BCD	67-72
202	L	6	83	38	0	6334	BCD	65-72
206	L	6	82	40	0	6236	BCD	63-70
204	L	5	82	36	0	6207	BCD	68-71
209	L	6	85	36	0	5947	CD	64-70
212	M	4	83	40	18	5733	D	61-67
C.V.		10.2	1.0	2.1	--	8.0		1.7-1.0

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 21. AGRONOMIC PERFORMANCE OF 1985 ADVANCED YIELD TESTS, GROUP XVIII.
LAKE ARTHUR, LA. - FIRST CROP.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
NEWBONNET	L	5	91	40	0	8379	A	51-68
203	L	6	85	34	0	8190	AB	60-70
212	M	3	87	34	0	8015	ABC	57-68
213	M	2	87	34	0	7910	ABCD	66-71
201	L	6	88	33	0	7839	BCDE	58-70
LEMONT	L	6	89	33	0	7679	CDEF	58-70
207	L	6	84	33	0	7438	DEFG	61-70
205	L	6	85	32	0	7403	EFG	64-71
209	L	6	88	33	0	7344	EFG	60-70
202	L	5	86	33	0	7337	EFG	59-71
204	L	6	85	31	0	7320	FG	62-71
208	L	6	86	37	0	7230	FG	57-69
206	L	6	85	35	0	7065	GH	59-70
MARS	M	3	90	40	83	6649	H	54-68
211	L	5	86	40	90	5512	I	59-71
210	L	5	85	39	88	4889	J	58-70
C.V.		9.7	1.0	3.7	--	4.3		4.5-1.3

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 22. AGRONOMIC PERFORMANCE OF 1985 ADVANCED YIELD TESTS, GROUP XVIII.
LAKE ARTHUR, LA. - SECOND CROP.

1985 ENTRY	GRAIN TYPE*	DAYS TO 50% HEADING	YIELD (LB/A @12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
LEMONT	L	89	2829	A	67-72
MARS	M	90	2799	AB	68-72
208	L	86	2739	AB	65-71
203	L	85	2703	AB	66-71
207	L	84	2645	ABC	65-71
213	M	87	2601	ABCD	65-71
212	M	87	2534	ABCD	65-71
201	L	88	2490	ABCD	64-71
205	L	85	2102	ABCDE	65-71
202	L	86	2052	BCDE	64-71
204	L	85	1908	CDE	65-71
206	L	85	1887	DE	64-70
209	L	88	1561	E	61-70
211	L	86	1527	E	63-72
210	L	85	1359	E	59-70
NEWBONNET	L	91	-		-- -
C.V.		1.0	20		2.8-1.1

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

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

TABLE 23. AGRONOMIC PERFORMANCE OF 1985 ADVANCED YIELD TESTS, GROUP XVIII.
LAKE ARTHUR, LA. - TOTAL YIELD.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	TOTAL YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
203	L	6	85	34	0	10893	A	63-71
212	M	3	87	34	0	10549	A	61-70
213	M	2	87	34	0	10510	A	66-71
LEMONT	L	6	89	33	0	10508	A	63-71
201	L	6	88	33	0	10329	AB	61-71
207	L	6	84	33	0	10083	ABC	63-71
208	L	6	86	37	0	9969	ABC	61-70
205	L	6	85	32	0	9504	BCD	65-71
MARS	M	3	90	40	83	9448	BCD	61-70
202	L	5	86	33	0	9389	CD	62-71
204	L	6	85	31	0	9228	CD	64-71
206	L	6	85	35	0	8952	D	62-70
209	L	6	88	33	0	8904	D	62-70
NEWBONNET	L	5	91	40	0	8397	E	51-68
211	L	5	86	40	90	7039	E	62-71
210	L	5	85	39	88	6248	E	59-70
C.V.		9.7	1.0	3.7	--	6.0		

* L = LONG GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 24. AGRONOMIC PERFORMANCE OF 1985 ADVANCED YIELD TEST, GROUP XVIII.
FIRST CROP, CROWLEY AND LAKE ARTHUR.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
NEWBONNET	L	4	89	44	0	7895	A	58-69
203	L	6	83	35	0	7480	AB	63-70
201	L	6	86	35	0	7401	B	62-71
213	M	3	85	37	11	7272	BC	66-71
LEMONT	L	6	87	36	0	7194	BCD	62-71
207	L	6	83	37	3	7031	BCDE	62-69
205	L	6	83	34	0	6922	CDE	65-71
208	L	6	85	39	0	6907	CDE	59-69
212	L	3	85	37	9	6874	DE	59-68
202	L	6	84	36	0	6835	DE	62-71
204	L	5	83	34	0	6764	DE	65-71
206	L	6	83	37	0	6651	E	61-70
MARS	M	3	87	44	84	6649	E	57-68
209	L	6	87	34	0	6645	E	62-70
211	L	5	84	44	85	5512	F	59-71
210	L	5	86	43	88	4889	G	58-70
C.V.		10	1	2.9	29.5	6.0		3.4-1.1

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 25). Head rice milling yield were also low due to a low harvest moisture. Table 26 summarizes agronomic performance of the entries over all three locations.

PRELIMINARY YIELD TESTS

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.

MATERIALS AND METHODS

Two hundred and thirty entries were evaluated in five groups in a randomized complete block design with two replications at the RRS. Entries were drill-seeded at 100 lb/A May 1, 1985. Preplant fertilizer was applied and incorporated at a rate of 60-60-60 lb/A total NPK and 100 lb N/A applied pre-flood. 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 and carbofuran were applied at recommended rates for weed and insect control, respectively. Each plot consisted of seven 8-in rows 16 ft in length. At harvest, a milling sample was taken, the plots were trimmed to 12 ft, and the center four rows harvested with a small plot combine. Samples were dried to approximately 12% moisture and yields determined and reported at a 12% moisture basis. In Group XVI, a single 12-ft row was harvested from each plot.

RESULTS AND DISCUSSION

Hurricane Danny hit the RRS just as the preliminaries were ripening and yield data were not collected on the very early entries (Group XII) and medium grains (Group XV) due to severe lodging. Tables 27 through 29 contain the performance results for groups XIII, XIV, and XVI. Tests from the later groups were satisfactory in 1985 and plot evaluation provided plant height, maturity, and yield information for selection decisions. Milling yields were low probably as a result of Hurricane Danny. These entries are being evaluated in more extensive testing in 1986. Group XVI contained a collection of induced mutants of a water weevil tolerant germplasm line WC 1711. Several entries showed good yield potential and are being considered for germplasm release.

GENETIC STUDIES

The rice breeding project continued some genetic studies of interest to varietal improvement. In 1984 an experiment was initiated to examine the inheritance of milling yield in two southern semidwarf long-grain varieties, 'Lemont' and 'Leah'. Milling studies at RRS have shown that these two varieties show quite different percent head rice yields. Lemont (LMNT) has shown high percent head rice yield which remains relatively high when harvested at different moisture contents. Leah (LEAH) percent head rice yields are lower than Lemont and decrease when harvested at low harvest moistures.

TABLE 25. AGRONOMIC PERFORMANCE OF 1985 ADVANCED YIELD TESTS, GROUP XVIII.
CHENEYVILLE, LA.

1985 ENTRY	GRAIN TYPE*	DAYS TO HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST **	MILLING % (WHL-TOT)
LEMONT	L	95	34	8	7410	A	45-70
201	L	93	32	18	6838	AB	41-69
205	L	92	34	0	6665	AB	46-70
NEWBONNET	L	95	39	0	6541	AB	52-68
203	L	92	33	0	6339	ABC	46-69
204	L	92	31	10	6067	BCD	47-70
202	L	93	34	0	5843	BCD	41-70
207	L	91	35	0	5683	BCD	42-68
209	L	93	37	25	5638	BCD	50-69
208	L	93	34	0	5608	BCD	43-69
206	L	91	34	0	5139	CDE	42-69
MARS	M	91	36	23	4822	DEF	56-69
211	L	92	36	3	4792	DEF	39-69
212	M	90	32	8	4210	EF	42-66
210	L	92	34	3	4045	EF	39-68
213	M	90	31	0	3563	F	48-68
C.V.		1.2	7.8	--	14.6		6.7-1.0

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

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

TABLE 26. AGRONOMIC PERFORMANCE OF 1985 ADVANCED YIELD TESTS, GROUP XVIII.
THREE LOCATIONS IN LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
NEWBONNET	L	4	91	42	0	7443	A	56-69
LEMONT	L	6	90	35	3	7266	AB	56-71
201	L	6	88	34	6	7213	AB	55-70
203	L	6	86	34	0	7100	ABC	57-70
205	L	6	86	34	0	6836	BCD	59-71
207	L	6	85	36	2	6582	CDE	55-69
204	L	5	86	33	3	6531	DEF	59-71
202	L	6	87	35	0	6504	DEF	55-71
208	L	6	88	37	0	6474	DEF	54-69
209	L	6	89	35	8	6310	DEF	58-70
206	L	6	86	36	0	6147	EFG	55-70
213	M	3	87	35	8	6036	EFG	60-70
212	M	3	87	35	8	5986	FG	54-67
MARS	M	3	88	41	63	5735	G	56-69
211	L	5	87	42	58	5152	H	50-70
210	L	5	88	40	59	4467	I	48-69
C.V.		10.0	1	4.9	72.8	9.2		4.4-1.0

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT 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 27. AGRONOMIC PERFORMANCE OF 1985 PRELIMINARY YIELD TESTS, GROUP XIII. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
610	L	8	83	35	0	7439	A	49-73
609	L	7	83	39	0	7426	A	45-71
594	L	5	84	40	5	7381	A	38-70
LEMONT	L	6	84	37	0	7188	AB	50-70
622	L	7	84	35	0	7175	AB	49-68
608	L	7	82	36	10	7150	ABC	62-71
621	L	6	81	36	0	7114	ABCD	58-70
579	L	6	80	39	5	7101	ABCDE	36-67
575	L	8	85	36	0	7081	ABCDEF	50-70
629	L	7	83	36	0	7049	ABCDEF	48-71
598	L	6	86	39	0	6975	ABCDEF	46-68
572	L	7	81	37	0	6974	ABCDEF	42-69
627	L	7	85	39	0	6952	ABCDEF	53-68
604	L	8	82	37	0	6880	A-I	53-72
626	L	7	86	35	0	6827	A-J	55-68
563	L	7	85	34	0	6824	A-J	52-68
599	L	8	85	36	0	6819	A-J	51-71
586	L	6	83	40	0	6766	A-K	39-70
569	L	6	82	45	15	6744	A-K	43-69
DELLA	L	7	81	39	0	6733	A-K	43-70
620	L	7	86	40	0	6694	A-K	45-70
595	L	7	80	34	0	6687	A-K	37-70
574	L	8	86	38	0	6668	A-K	49-69
602	L	5	88	43	0	6646	A-K	54-68
585	L	5	82	39	0	6641	A-K	37-69
587	L	7	83	39	0	6621	A-K	34-69
615	L	8	83	36	0	6617	A-K	54-71
577	L	8	84	37	0	6614	A-K	50-70
581	L	5	83	43	5	6603	A-K	38-70
588	L	5	81	39	5	6588	A-K	53-70
606	L	6	88	40	0	6550	A-K	60-70
578	L	7	82	37	0	6506	A-L	25-70

CONTINUED.

TABLE 27. AGRONOMIC PERFORMANCE OF 1985 PRELIMINARY YIELD TESTS, GROUP XIII. RICE RESEARCH STATION, CROWLEY, LA. CONTINUED.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
625	L	8	84	39	0	6489	A-K	42-70
614	L	8	81	37	0	6487	A-K	56-69
603	L	6	84	42	0	6412	A-M	51-68
591	L	6	79	30	0	6392	A-M	45-69
617	L	5	80	43	0	6389	A-M	52-68
583	L	7	76	38	0	6387	A-M	51-68
596	L	6	80	37	0	6383	A-M	53-69
573	L	7	82	36	0	6350	A-M	57-68
605	L	7	82	38	0	6322	A-N	56-70
619	L	4	84	41	0	6281	A-N	50-67
624	L	7	84	39	0	6269	A-N	41-70
593	L	7	84	34	0	6264	A-N	46-68
589	L	7	84	40	5	6252	A-N	51-69
582	L	6	82	43	0	6244	A-N	39-69
600	L	7	88	40	0	6240	A-N	55-68
570	L	6	84	47	30	6203	A-N	47-70
568	L	6	83	46	5	6200	A-N	46-69
612	L	6	83	38	0	6156	A-O	57-70
590	L	6	83	35	0	6147	A-O	41-67
613	L	5	84	39	5	6141	A-O	54-68
584	L	6	80	40	0	6127	A-O	36-69
623	L	7	84	38	0	6024	A-O	46-69
566	L	6	79	38	0	5904	B-P	53-68
633	L	8	86	45	15	5884	B-P	38-69
628	L	8	87	45	10	5859	B-P	48-70
571	L	6	85	42	10	5841	B-P	54-69
580	L	7	80	41	10	5809	B-P	52-71
631	L	6	85	51	80	5734	C-P	24-70
635	L	3	77	41	5	5706	D-P	45-69
567	L	6	77	36	20	5675	E-Q	51-69
634	L	4	77	42	0	5664	F-Q	46-69

CONTINUED.

TABLE 27. AGRONOMIC PERFORMANCE OF 1985 PRELIMINARY YIELD TESTS, GROUP XIII. RICE RESEARCH STATION, CROWLEY, LA. CONTINUED.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
597	L	7	84	38	0	5626	G-Q	51-66
LEAH	L	4	83	43	45	5572	H-Q	49-70
632	L	8	86	52	65	5522	I-Q	42-69
630	L	7	83	41	0	5508	I-Q	34-69
565	L	5	80	41	70	5443	J-Q	50-66
638	L	7	86	50	60	5429	J-Q	42-70
592	L	7	84	42	0	5383	K-Q	44-66
618	L	5	84	42	0	5105	L-Q	54-69
611	L	7	81	34	0	5052	M-Q	46-66
616	L	4	76	42	80	4913	N-Q	56-70
601	L	5	73	38	70	4787	O-Q	53-68
636	L	4	80	41	5	4535	P-Q	52-67
637	L	5	83	46	70	4320	Q	45-70
564	-	5	77	46	90	-		51-69
C.V.		12.9	1.0	3.6	--	9.0		7.6-1.5

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 28. AGRONOMIC PERFORMANCE OF 1985 PRELIMINARY YIELD TESTS, GROUP XIV. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT))
659	L	6	82	38	0	7657	A	43-72
643	L	5	85	42	0	7340	AB	42-69
644	L	6	88	35	0	7175	ABC	55-70
656	L	7	82	40	0	7139	ABCD	28-70
649	L	5	88	41	0	7013	ABCD	54-70
646	L	6	86	43	0	6982	ABCDE	45-68
658	L	6	82	38	0	6977	ABCDE	46-72
664	L	6	75	37	25	6953	ABCDE	47-70
651	L	5	87	39	0	6921	ABCDE	55-70
650	L	5	86	39	0	6835	ABCDE	50-69
648	L	5	88	43	0	6817	ABCDE	53-71
654	L	5	87	42	0	6615	ABCDE	55-70
NEWBONNET	L	5	85	47	0	6576	ABCDE	57-68
647	L	5	85	42	0	6563	ABCDE	50-68
657	L	5	84	44	0	6525	ABCDE	42-71
670	L	5	82	39	10	6437	ABCDE	50-64
641	L	5	85	44	0	6418	ABCDE	54-66
660	L	7	84	34	0	6391	ABCDE	52-68
652	L	5	89	42	0	6338	ABCDE	47-67
642	L	5	89	42	0	6148	BCDEFG	55-67
667	L	6	83	37	60	6141	BCDEFG	52-68
661	L	7	82	33	0	6055	BCDEFG	42-68
666	L	7	85	38	0	5988	CDEFGH	42-67
674	L	5	77	41	0	5817	DEFGH	57-68
645	L	6	86	44	0	5656	EFGH	54-68
675	L	5	68	38	75	5102	FGHI	43-66
665	L	8	85	37	0	4962	GHI	46-66
653	L	6	88	39	80	4942	GHI	46-64
673	L	4	75	43	70	4761	HI	53-67

CONTINUED.

TABLE 28. AGRONOMIC PERFORMANCE OF 1985 PRELIMINARY YIELD TESTS, GROUP XIV. RICE RESEARCH STATION, CROWLEY, LA. CONTINUED.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO 50% HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT))
676	L	7	83	46	10	4390	I	54-70
671	L	5	74	45	55	4337	I	48-68
672	L	6	74	35	40	3908	I	42-67
C.V.		12.0	1.0	3.8	--	8.8		

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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 29. AGRONOMIC PERFORMANCE OF 1985 PRELIMINARY YIELD TESTS, GROUP XVI. RICE RESEARCH STATION, CROWLEY, LA.

1985 ENTRY	GRAIN TYPE*	SEEDLING VIGOR**	DAYS TO HEADING	PLANT HGT(IN)	LODGING (%)	YIELD (LB/A @12%)	DUNCAN'S TEST ***	MILLING % (WHL-TOT)
723	S	7	90	42	35	8501	A	67-69
720	S	6	89	43	35	8272	AB	69-70
716	S	7	89	44	30	8170	AB	67-69
711	S	6	91	44	55	8143	AB	66-69
713	S	7	89	43	30	7847	AB	68-70
715	S	6	89	49	50	7684	ABC	68-71
726	S	7	92	44	45	7509	ABC	69-72
724	S	7	88	42	35	7398	ABCD	66-69
708	S	7	92	47	45	7307	ABCD	68-71
MARS	M	4	81	50	85	7285	ABCD	55-68
714	S	6	90	50	65	7261	ABCD	68-72
718	S	7	92	47	70	7047	ABCDE	68-71
709	S	7	95	49	50	7006	ABCDE	70-72
712	S	6	89	49	80	6573	BCDE	67-70
WC 1711	S	7	92	57	90	6080	CDEF	68-73
719	S	8	90	44	35	5727	DEFG	65-70
727	S	7	88	53	90	5719	DEFG	-- --
722	S	7	90	39	30	5506	EFG	66-71
717	S	7	86	47	85	5355	EFGH	62-67
725	S	4	85	40	30	4840	FGH	60-65
710	S	6	75	46	85	4355	GH	59-70
721	S	7	93	29	0	3748	H	55-60
C.V.		13.4	1.0	3.0	--	10.3		2.9-1.6

* L = LONG-GRAIN, M = MEDIUM-GRAIN, S = SHORT, 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.

MATERIALS AND METHODS

Two hundred and sixteen LMNT/LEAH F_4 lines were grown in 6-ft rows in 1985. The experimental design was a randomized complete block with three replications. Each F_4 line traced back to F_3 line grown in 1984 and an individual LMNT/LEAH F_2 plant. Check rows of LMNT and LEAH were included in each replication. All lines in a replication were cut and threshed in 1 day and harvest moistures determined on each line. Replications 1, 2, and 3 were harvested on September 28 and 30 and October 2, 1985, respectively. Samples were dried to 12% moisture and milling yield determined on a 50-gram sample using a modified McGill rice mill.

RESULTS AND DISCUSSION

The head rice milling yields were severely depressed in 1985, probably as the result of the three hurricanes that struck Louisiana. The parents exhibited distinct milling differences in both 1984 and 1985. Frequency distributions for percent head rice in the F_3 and F_4 populations were continuous and unimodal. F_4 - F_3 regression and correlation coefficients were 0.50 and 0.72, respectively. Broadsense heritability estimates for the F_3 and F_4 populations were 0.76 and 0.52, respectively. The h^2 value based on the Smith and Kinman (1965) correction for continuous self-pollinations was estimated to be 0.29. Correlations among percent head rice, harvest moisture, heading date, and kernel dimensions were also calculated. Further analysis of these data will be continued in 1986.

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

(A Progress Report)

K.S. McKenzie, F. Jodari, A. Godeaux, R. Pollingue, 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 having 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

- 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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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).

The Agricultural Experiment Stations of Arkansas, Louisiana, Puerto Rico, and Texas have entered into a cooperative agreement to develop and 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.

1985-86 ACTIVITIES

The first planting was made on the new nursery site January 17 and 18, 1985. Persistent rainfall delayed planting which had been scheduled for earlier in the fall of 1984. The nursery was planted by F. Jodari and A. Godeaux of the Rice Research Station (RRS) and J.E. Scott of Texas A&M. A new mechanical nursery seeder was successfully used to plant the entire nursery which contained over 9,000 rows in less than 2 working days with relatively few problems. Growth and seed production of the new nursery site was good. Some problems with deep water were encountered and efforts to correct this were made during the summer of 1985. Variability in soil fertility was also noted as the nursery site had previously been in pasture for many years. The entire nursery was covered with netting which was very effective in preventing feeding damage by birds. A meeting of the nursery cooperators was held May 20, 1985 at Mayaguez to discuss the operation of the nursery. A new cooperative agreement will be developed and implemented in 1986. Harvest of the nursery was completed in June of 1985, and selections from the Louisiana nursery were grown at the RRS during the summer of 1985.

A September planting was scheduled, however, heavy rainfall and flooding occurred at Lajas just prior to planting. Planting was delayed until December 1985 when F. Jodari traveled to Lajas to try to expedite a December planting. A heavy growth of weeds had infested the nursery site. The weeds were mowed and several diskings were used to prepare a seedbed. K.A. Moldenhauer and J.E. Scott cooperators from Arkansas and Texas were then able to plant the nursery (9,000 rows) December 18, 1985. The rice had emerged by January 1986. Harvest is scheduled for May 1986.

RICE GENETICS

CHROMOSOME PAIRING IN ORYZA SATIVA L. X O. LATIFOLIA DESV. HYBRIDS

(A Progress Report)

E. M. Nowick

INTRODUCTION

The Oryza genus includes about 30 species divided into three sections (Sharma, 1983). The Oryza section is further divided into two series: sativae and latifoliae. Species in the sativae section are closely related to the cultivated Oryza sativa. Chromosomes in F_1 hybrids from crosses among the sativae species pair normally, and although some sterility is observed, genes can be transferred by backcrossing. In crosses between O. sativa and the latifoliae species, however, gene transfer is prevented by F_1 inviability and by lack of chromosome pairing. This lack of chromosome pairing prevents the transfer of useful genes for disease and insect resistance. The regeneration of hybrid plants from callus tissue derived from embryos of O. sativa AA X O. latifolia CCDD and O. glumaepatula A^{cu}A^{cu} X O. latifolia CCDD cross has been previously reported. This year meiotic chromosomes from the regenerated hybrid plants were examined.

MATERIALS AND METHODS

Embryos from crosses between O. sativa cv Mars X O. latifolia IRRI Acc No 100914 and between O. glumaepatula PI 346368 X O. latifolia IRRI Acc No 100914 were cultured and plants regenerated as previously reported. Immature panicles were collected from the regenerated plants at meiosis and fixed in 3:1 ethanol:acetic acid for at least 48 hours. Fixed anthers were squashed in 60% acetic acid, the coverslips were removed by freezing, and the slides allowed to air dry. Slides were stained with pinacyanol chloride using the method of Klinger and Hammond (1971). Prior to staining, the slides were extracted in 5 N HCl for 2 minutes and then washed in tap water for 2 minutes to clear the cytoplasm. Chromosome counts were made under oil immersion at 1000X.

RESULTS AND DISCUSSION

Meiosis was examined in 9 of the 12 hybrid regenerants. The average number of bivalents for the O. sativa X O. latifolia regenerants ranged from 13.79 to 14.79 (Table 1). From 10 to 18 bivalents were observed per cell. Some of the variability in the number of bivalents was apparently due to desynapsis. Occasionally disjoining pairs were seen, but most chromosomes remained paired until anaphase. The average number of bivalents in the O. glumaepatula X O. latifolia regenerants was slightly less than in the O. sativa X O. latifolia hybrids, ranging from 12.44 to 13.87. Bivalents per cell ranged from 10 to 17.

The high number of bivalents seen in these crosses suggests the presence of a pairing promoter system similar to the genes controlling chromosome pairing in wheat. Further genetic analysis is prevented in the crosses studied by total F_1 sterility, but because a genetic pairing promoter could allow the transfer of traits such as stem rot resistance to cultivated rice from its distant relatives, additional crosses are being made.

LITERATURE CITED

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2. Sharma, S.D. 1983. Conservation of wild species of *Oryza*. pp. 21-25 in Rice germplasm conservation workshop. IRRI. Los Banos, Laguna, Philippines.

Table 1. Average number of chromosome pairs in interspecific hybrid regenerants. Observed in tests at the Rice Research Station, Crowley, LA. 1985.

Cross	Regenerant number	Number of cells counted	Average number of bivalents	Range observed	sd
<u>O. sativa</u> x	1	62	14.19	10-17	2.37
<u>O. latifolia</u>	2	53	14.02	10-18	2.01
	5	62	14.79	10-17	2.37
	6	38	13.79	12-18	2.33
	8	20	13.85	12-17	2.54
	16	32	14.12	12-18	2.39
<u>O. glumaepatula</u>	10	39	13.87	10-16	2.50
x <u>O. latifolia</u>	12	26	12.88	11-17	1.76
	13	39	12.44	11-14	2.70

DEVELOPMENT OF RICE WATER WEEVIL RESISTANT GERMPLASM

(A Progress Report)

E.M. Nowick and J.F. Robinson

INTRODUCTION

The rice water weevil (RWW) is the most economically important insect pest of rice in Louisiana. Primary damage to the rice plant is caused by larvae feeding on roots. The known sources of resistance are only partially effective. Resistance ratings based on larval counts per sample from the field are highly variable and, because sampling is time consuming, the number of samples that can be evaluated is limited. The usefulness of the available partially resistant lines for breeding will depend on how effective selection of the more resistant lines among segregating populations will be under these circumstances.

Realized heritabilities have been calculated from F_2 and F_3 data collected during 1984 and 1985 as indicators of the genetic improvement in resistance that could be expected using the currently available sources.

MATERIALS AND METHODS

A total of 1,361 F_3 lines and parental controls derived from 25 crosses among commercial varieties, partially resistant lines, and one tolerant line were evaluated this past summer. Five-gram samples were randomly planted in 6-ft rows with 1½-ft spacings and 3-ft walkways. The rows were divided into 13 tiers.

Core samples were collected starting at 6 weeks after planting from each F_3 line and the number of larvae per core counted and recorded. Because of the time involved in collecting samples, larval counts increased with row number. To eliminate this effect, the count from each row was divided by the tier average.

The counts from individual F_2 plants were determined as reported previously. Correlations between F_2 plants and F_3 lines were calculated for each cross and also realized heritability at a 25% selection differential where:

$$r_{H2} = \frac{\bar{x}F3 - \bar{x}SF3}{\bar{x}F2 - \bar{x}SF2}$$

$\bar{x}F3$ = Mean of all $F3$ lines/cross
 $\bar{x}SF3$ = Mean of $F3$ lines selected in $F2$
 $\bar{x}F2$ = Mean of all $F2$ plants in cross
 $\bar{x}SF2$ = Mean of selected $F2$ plants

RESULTS AND DISCUSSION

Realized heritabilities for the Lemont x partially resistant lines ranged from -6.36 to 45.45% (Table 1). Lemont is somewhat resistant to rice water weevils and has a similar pedigree to a number of the partially resistant lines, but from the realized heritabilities, it would appear that improvement could be made by breeding. In the PI 321264/Lemont cross, the mean of the selected lines in the F_3 showed a nearly 50% reduction in larval numbers from the Lemont parent.

Estimates of realized heritabilities from the Mars crosses ranged from 17.49 to 29.37% (Table 2). Mars is more susceptible to RWW's than Lemont and differs in pedigree from the donor lines and so would be expected to show positive response to selection in more crosses than Lemont. However, while heritability was positive in all three crosses, the reduction in larvae in the selected lines was only about 25%.

Realized heritabilities from the crosses to the tolerant line CI 11048 were slightly negative for all lines but Mars (Table 3). This tolerant line shows little yield reduction under infestation because of its high root regrowth potential, but because it supports a large larval population, selection on larval count alone will not have much effect on genetic improvement in these crosses.

Realized heritabilities from crosses among the resistant lines were variable and inconsistent (Table 4). Of the six partially resistant lines identified in screening of the rice world collection and included in this study, four are selections from Bluebelle/3*TN1; one is a selection from Bluebelle/3*YAl; while only one, PI 210387, is an unrelated line. Because neither Bluebelle nor Taichung Native 1 shows any resistance to RWW, it appears that the trait must be polygenic possibly with a threshold effect. Parental variabilities are very high and it is difficult to detect transgressive segregation, but of the resistant crosses tested, only three show possible evidence of gene complementation. In these three crosses, PI 321314/210387, PI 321294/321314, and PI 321294/321278, the mean of the selected lines was lower than the mean of either parent. The F_3 means for the other crosses were generally intermediate between the two parents and means of the selected lines were also intermediate or approached the more resistant parent.

Results from this study indicate that some improvement could be made in RWW resistance using the partially resistant lines. However, to bring the level up to commercially acceptable limits, it will probably be necessary to combine resistance with tolerance in a commercial line or to utilize several complimentary sources of resistance. Four-way crosses utilizing the most promising lines will be evaluated along with the best selections from the F_3 lines during 1986.

Table 1. Realized heritability for RWW resistance in populations derived from crosses between partially resistant lines x Lemont. Rice Research Station, Crowley, LA. 1985.

P1	P2	$\bar{x}F3$	$\bar{x}SF3$	rH^2
PI 210387	Lemont	1.06	1.10	-6.36
PI 321294	Lemont	1.02	.87	22.00
PI 321264	Lemont	.81	.49	45.45
PI 321308	Lemont	.95	.86	16.68
PI 321314	Lemont	.92	.94	-4.77

Table 2. Realized heritability for RWW resistance in populations derived from crosses between partially resistant lines x Mars. Rice Research Station, Crowley, LA. 1985.

P1	P2	$\bar{x}F3$	$\bar{x}SF3$	rH
PI 210387	Mars	1.08	.92	29.37
PI 321264	Mars	1.14	1.06	17.49
PI 321308	Mars	1.09	.92	21.23

Table 3. Realized heritability for RWW resistance in populations derived from crosses between the tolerant lines CI 11048 and partially resistant or commercial varieties. Rice Research Station, Crowley, LA. 1985.

P1	P2	$\bar{x}F3$	$\bar{x}SF3$	rH
PI 210387	CI 11048	.95	.97	-3.48
PI 321294	CI 11048	1.03	1.03	0.00
PI 321264	CI 11048	1.11	1.16	-10.53
CI 11048	Mars	.97	.84	19.61
CI 11048	Lemont	.97	1.00	-6.61

Table 4. Realized heritabilities for RWW resistance in populations derived from crosses among partially resistant varieties. Rice Research Station, Crowley, LA. 1985.

P1	P2	$\bar{x}F3$	$\bar{x}SF3$	rH
PI 210387	PI 321294	1.00	.85	34.96
PI 210387	PI 321264	1.04	1.16	-34.06
PI 210387	PI 321308	1.09	1.00	16.80
PI 210387	PI 321278	.92	1.02	-12.73
PI 321314	PI 210387	.92	.80	21.08
PI 321294	PI 321308	1.10	.90	34.69
PI 321294	PI 321278	.66	.57	84.59
PI 321294	PI 321314	.92	.76	29.86
PI 321264	PI 321314	1.05	1.06	-1.67
PI 321264	PI 321308	1.07	1.01	9.21
PI 321264	PI 321278	1.07	1.03	7.34
PI 321308	PI 321278	.95	.88	13.23
PI 321308	PI 321314	.99	1.11	-20.41

SELECTION OF SHEATH BLIGHT RESISTANCE BACKCROSS
PROGENY BASED ON INFECTION STRUCTURE NUMBER

(A Preliminary Report)

E.M. Nowick and D.E. Groth

INTRODUCTION

Sheath blight is one of the most important diseases of rice in Louisiana. Several world collection lines have been identified that show consistently high levels of resistance to the disease under field conditions, but the lines with the highest levels of resistance have poor agronomic quality. A number of backcrosses will be required to transfer resistance and recover the good agronomic type of the recurrent parent. Because field variability of disease resistance is high, individual resistant plants cannot be selected in a segregating population and so the process of transferring genes is slowed by the necessity of inbreeding to get enough seed for a reliable test.

The resistant variety 'Tetep' has been found to have abundant wax deposits on the outer leaf sheaths and on these varieties the causal fungus, Rhizoctonia solani, formed fewer infection structures (Marshall and Rush, 1980). The wax is thought to prevent leaching of an inducer of penetration structure formation rather than acting as a mechanical barrier. This mechanism of resistance is not completely effective and a second post-penetrational mechanism is also present which causes the buildup of colored compounds in lesions formed on the lines with this type of resistance. These two mechanisms of resistance appear to be controlled by two or three major genes. Because appressoria formation and lesion type are less influenced by environment than disease development, it may be possible to select individual plants with resistance on this basis in backcross progeny speeding transfer of resistance into commercial varieties.

MATERIALS AND METHODS

Crosses were made between the resistant variety 'Tetep' and the susceptible commercial variety 'Lemont'. The first backcross generation (BC1) was rated for resistance in the greenhouse in the winter of 84-85, the BC2 in the summer of 85, and the BC3 in the winter of 85-86.

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 with daily shaking.

Thirty-day old seedlings were inoculated by placing a small piece of infected rice hull under the outer leaf sheath at the water level. High humidity was maintained during disease development. After 48 hours, the infected leaf sheaths were collected and placed in fixative. Sections of the leaf sheath were stained by simmering for 3 minutes in aniline blue-lactophenol

and the number of infection structures formed within .5 cm² from the point of inoculation was determined. Post-penetrational resistance was rated visually as width of red margins on lesions 96 hours after inoculation.

RESULTS AND DISCUSSION

Abundant surface hyphae were seen in the resistant parents with relatively few appressoria or infection cushions. Lesions formed had wide red margins. In the susceptible parent many infection cushions were observed and large, watery lesion with narrow margins were formed. In each of the backcross generations individual plants with the disease reaction of the resistant parent were observed and these plants were again backcrossed. This summer the selfed progeny from each backcross generation will be tested for disease reaction in the field to determine the effectiveness of the selection method.

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RICE TISSUE CULTURE RESEARCH

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

(A Progress Report)

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

INTRODUCTION

Red rice is one of the most common and troublesome weeds of rice in the southern United States. Estimates of losses caused by this weed run as high as 50 million dollars annually in the U.S. crop. These losses are due to a reduction in quality and price caused by the presence of red grains in the white commercial rice, and to production losses due to competition and reduced yield.

The development of rice cultivars which are genetically tolerant to herbicides effective on red rice would greatly facilitate control of this pest in rice fields. Its close genetic relationship to domestic rice makes it particularly hard to control because herbicides which inhibit red rice also inhibit domestic rice.

Using tissue culture techniques in the laboratory, large numbers of rice cells from commercial rice varieties can be exposed to herbicides that are known to be effective on red rice. While most of the commercial rice cells will be killed, within a large number of cells there are usually occasional mutant cells that are resistant to the herbicide and can therefore continue to grow. These mutant cells are then induced to develop into whole plants, which should also be resistant. A second approach is to test plants regenerated from rice cells in other projects within the overall rice tissue culture program, including those from cells never exposed to herbicides. Since plants developed from cells frequently possess new mutations, this approach may serve to identify any tissue culture induced mutations conferring herbicide resistance. The third approach used is a screening of commercial rice varieties and breeding lines for material possessing inherent resistance to herbicides. The fourth approach is a greenhouse screening for resistance to herbicides among rice seed in which mutations have been induced through exposure to gamma rays from radioactive Cobalt-60. After testing, any plant identified as resistant to herbicides through these various approaches can then form the starting material for a seed increase and varietal release program. Having originally used a herbicide that was effective on red rice, crops of this new herbicide-resistant commercial rice could be sprayed with the herbicide to kill any red rice growing in the stand.

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

MATERIALS AND METHODS

A total of 679 rice lines developed through conventional breeding, tissue culture, and mutation breeding techniques were tested for herbicide resistance during 1985. Seeds of each line were dehulled, surface sterilized, and aseptically pregerminated before transfer of 3 seeds to a test tube containing 1.0 part per million (ppm) sterilized Dual (metolachlor) solution. For comparison, three pregerminated seeds for each line were transferred to a tube containing only sterile water. At seven days following transfer, shoot length of the best growing seedling in each tube was measured.

RESULTS AND DISCUSSION

Of the 679 lines tested, 38 showed some degree of herbicide resistance as indicated by seedling shoot growth of an inch or more despite exposure to Dual.

CELLULAR AND MOLECULAR GENETICS FOR CROP IMPROVEMENT

(A Progress Report)

T.P. Croughan and M.M. Pizzolatto

INTRODUCTION

Tissue culture techniques offer the potential for contributing to the varietal improvement of rice in several ways, one of which is through the production of new genetic variability not currently available to breeders. A relatively new area of interest in tissue culture is the genetic variability resulting from the cloning of plants from cultured cells. It is now well documented that regenerated plants frequently possess traits not found in the plants from which the cells were initially obtained. A study with sugarcane, for example, regenerated plants from cell lines which had been derived from a disease-susceptible variety. While most of the regenerated plants remained susceptible, 20% of the regenerates possessed an increased resistance to the disease. While the basis for this genetic variability is not yet understood, it is now recognized that simply regenerating plants from non-selected cells can provide a source of variability for potential use in crop improvement. The term which has been adopted for this variability derived through tissue culture is somaclonal variability.

High rates of plant regeneration from cultured cells greatly enhances the potential application of somaclonal variability to crop improvement. Immature panicles of rice have been identified as an explant source from which cells with high rates of regeneration proliferate.

The study described in this report evaluated a number of different nutrient media in an attempt to maximize the rate of plant regeneration from immature panicle-derived cell lines.

MATERIALS AND METHODS

Foundation seed fields of the rice variety 'Lemont' at the L.S.U. Rice Research Station were used to collect approximately 2000 rice shoots containing immature panicles 1.0 to 2.0 inches in length. Following surface sterilization of the shoots, immature panicles were aseptically excised, cut into pieces, and placed on several different culture media. Callus which formed was transferred to regeneration media to induce the development of plants from the proliferating cell cultures.

RESULTS AND DISCUSSION

A total of eight different nutrient media were evaluated for their influence on callus formation and plant regeneration rates. All of the media tested were effective in inducing extensive callus formation. However, two of the media were clearly superior with respect to rates of plant regeneration from the proliferating cells. The two superior media were Schenck and Hildebrandt and Chaleff's R4.

IMPROVEMENT OF WHEAT AND FORAGE CROPS THROUGH TISSUE CULTURE

(A Progress Report)

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

INTRODUCTION

The application of tissue culture techniques to crop improvement involves the manipulation of plants at the cellular level. Two approaches are typically employed in developing superior plants from laboratory-cultured cells. The first approach entails the screening of large numbers of cells to identify occasional mutant cells possessing certain desirable traits. These cells are then induced to regenerate into whole plants which are tested for expression of the trait. The alternative approach does not entail a screening step, but simply the regeneration of plants from non-selected cells as efficiently as possible, followed by a testing of the regenerated plants for any improvements they may possess over the starting material.

Both of these techniques have been productive in the development of improved plants. Cells selected for resistance to salt, herbicides, or disease have regenerated plants which also possess resistance. However, plants with improved resistance have also been developed through regeneration from non-selected cells, as have plants which mature earlier and are shorter in stature. While the mechanisms underlying variability produced through tissue culture is not yet understood, it is now recognized that regenerated plants frequently possess genetic traits which were not present in the cultivar or breeding line from which they were derived.

MATERIALS AND METHODS

Callus cultures were initiated from immature embryos of three wheat varieties cultivated in Louisiana. Spikes of the varieties Coker 762, Coker 916, and Roy were collected at 12 days following spike emergence. Immature embryos were aseptically dissected and plated onto callus induction medium. Callus formed on nearly all embryos within 2 to 6 weeks. Callus tissue was excised and transferred to regeneration medium which induced extensive plantlet formation. Young plantlets were transferred to culture tubes containing distilled water to encourage root development. Rooted plants were transferred to soil in the greenhouse or growth chamber. At maturity many of the regenerated plants showed differences in such characters as height, leaf shape, and spike morphology. A total of 217 lines produced seed, which was collected and used to start transplants in peat pots in the greenhouse.

Three plantings were made with each line and their respective checks. One plant from each line was potted and kept in the greenhouse. The warm greenhouse temperature was used to screen for lines which did not require vernalization to flower. A second planting entailed transplanting five plants from each line to rows in the field with 1-foot spacing between plants in the row and 3 feet between rows. A check row of the original variety was planted every 20 rows.

The third planting entailed a completely randomized transplanting of 10 plants per line with spacing of the plants 4 feet apart in each direction. All field transplants were fertilized with 25-75-75 lb/A of $N-P_2O_5-K_2O$ at transplanting followed by a topdressing of 100 lb N/A in the spring.

RESULTS AND DISCUSSION

Over 95% of the plants survived transplanting and are well established in the field. Information will be collected on days to flowering, mature plant height, tiller number, spike weight, grain weight, and disease susceptibility.

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

(A Progress Report)

T.P. Croughan, K.S. McKenzie, and M.M. Pizzolatto

INTRODUCTION

Rice breeding programs typically require several years to develop and release a new commercial variety. About half of these years are spent acquiring true-breeding (homozygous) lines from the hybrid (heterozygous) individuals which result from a cross. Repeated selfing over several generations is conventionally used to achieve homozygosity within breeding lines. The techniques of pollen and anther culture provide the potential of a more rapid alternative in which homozygous breeding lines are obtained in the laboratory during the course of a year or less.

The original work on rice anther culture was carried out in Japan and reported in 1968. Considerable subsequent work, primarily by Japanese and Chinese researchers, has been directed towards refinement of the techniques and procedures involved. Noteworthy findings included the development of improved culture media, identification of the pollen growth stage most suited to subsequent culture, and the finding that a cold pretreatment enhances pollen culturability.

Anther culture activities for 1985 in this project included: 1) a screening of 10 indica rice varieties for genetic differences in rates of callus formation and plant regeneration from cultured anthers, and 2) plating of approximately 60,000 anthers from several F_1 and F_2 breeding lines.

MATERIALS AND METHODS

1. Anther Culture of F_1 and F_2 Hybrids

Plant materials used in this study were collected from the breeding nursery at the LSU Rice Research Station. The F_1 hybrids utilized primarily consisted of crosses between high-yielding U.S. varieties and agronomically unacceptable but highly disease resistant foreign types.

Shoots were collected when the distance from the flag to the penultimate leaf collars was approximately 5 cm. Following removal of leaf blades, the culms were placed in polyethylene bags and given a cold treatment of 12°C for 12 days. Each culm was then surface-sterilized by soaking for 30 minutes in a 50:50 solution of commercial bleach and water. Following aseptic removal of the panicle from the boot, anthers from the uppermost 10 florets on each panicle were plated onto 10 ml of agar-solidified Chaleff's R-4 nutrient medium

in a 35 x 10 mm polystyrene petri dish. Following a 3-week incubation in the dark at 27°C, the plated anthers were given a 16:8 hour light:dark regime of low intensity fluorescent light.

2. Indica Varieties

A total of 10 indica varieties were tested. The material was handled in the same manner as the anthers collected from the F_1 and F_2 breeding lines.

RESULTS AND DISCUSSION

Obvious differences in the capacity to form callus from anthers and to regenerate plants existed between different varieties. As reported in the literature, indica varieties have lower rates than both japonica rices and southern U.S. commercial rice varieties. The varieties Lemont, Guichow, IR36, and Tetep have complementary characteristics with respect to callus formation and plant regeneration. These varieties will be used to make crosses to study the genetic basis of these traits.

MILLING CHARACTERISTICS AND CAPABILITIES OF NEW VARIETIES OF RICE

(A Progress Report)

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

INTRODUCTION

Milling data, as related to grain moisture at time of harvest, have been obtained for several years for a number of long-grain varieties of rice grown in this area of the United States.

'Tebonnet', the only variety used in this study for the year 1985, was developed and released by the University of Arkansas/USDA in 1984. It is a long-grain, very early maturing tall variety.

MATERIALS AND METHODS

The border area along one of the plant breeders experimental plots was divided into four sections for replicated samples. Fertilizer practices were the same as would be used in a commercial field. Harvesting was done by hand at approximately the same time of day every 2 or 3 days except near the end when Hurricane Danny passed through this area. Sampling was commenced on August 19 when the grain moisture was about 26.5% (wb) and continued until September 19 when the grain moisture was approximately 11.5% (wb). Threshing of samples was accomplished using a laboratory thresher. Initial grain moisture was taken before drying samples to about 12.5% (wb), using a small forced air drier. A grain temperature of 38 to 40°C (100 to 105°F) was maintained during the drying process. After drying, the samples were sealed in glass jars and stored for 1 to 1½ months at room temperature before milling. Standard laboratory milling equipment and grading procedures were used to obtain milling yields. Statistical analysis of data was done at the Rice Research Station with an IBM PC, XT computer.

RESULTS AND DISCUSSION

Results of the milling and the analysis of variance for Tebonnet are shown in Figure 1 and Table 1.

The mean percent of brown rice was 82.7 and ranged from a low of 82.5 to a high of 83.1. The percent brown rice versus harvest moisture showed a linear relationship with little change in percent brown as the harvest moisture decreased.

The total milled rice yield ranged from a high of 71.8% to a low of 66.4% and averaged 68.5%. Regression of percent total milled rice over harvest moisture also showed a linear relationship with a small increase in total milled rice as harvest moisture decreased.

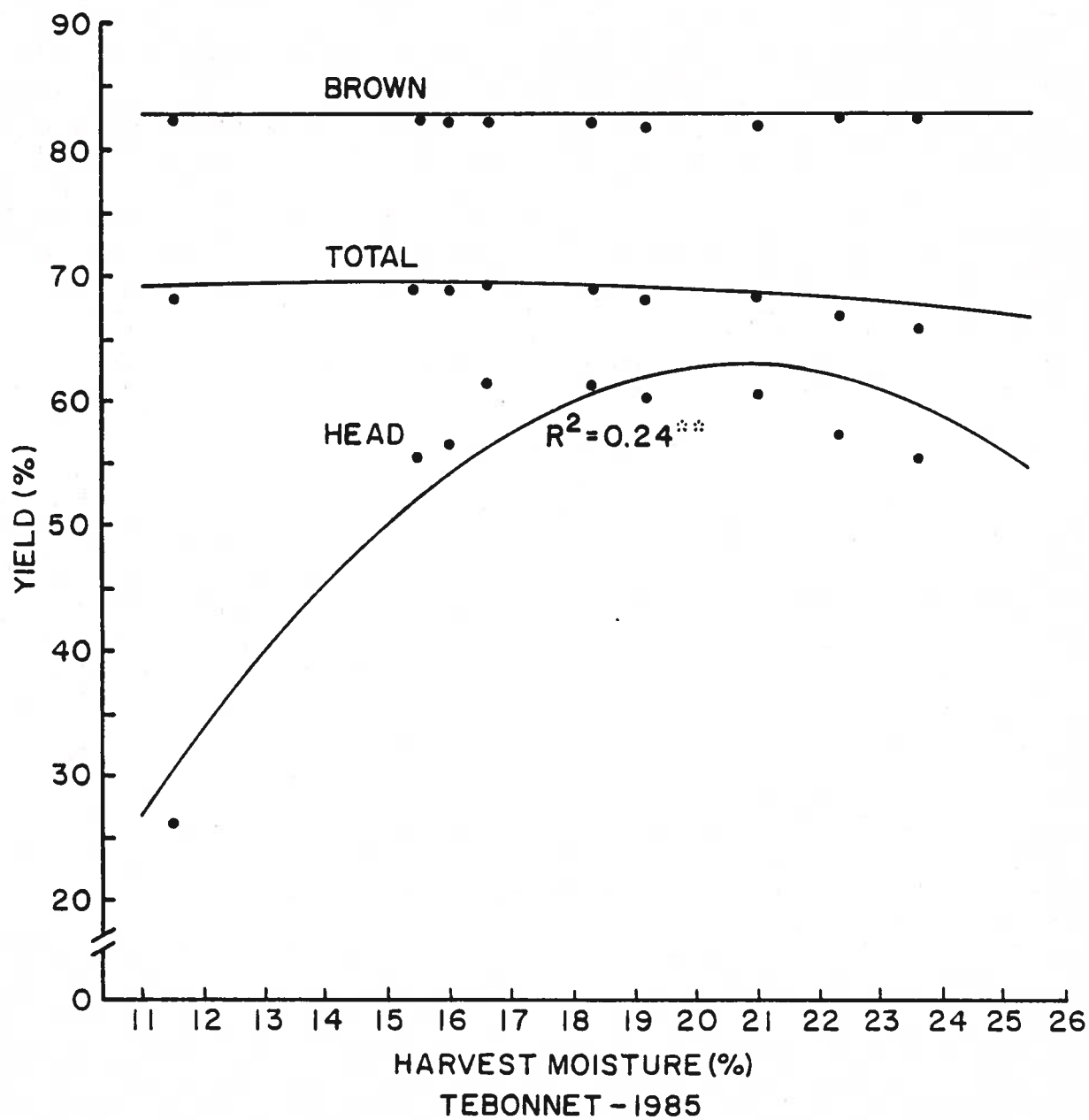


Figure 1. Relationship between milling yields and harvest moisture for brown rice, total milled rice, and head rice. Rice Research Station, Crowley, LA.

Table 1. Mean square of harvest moisture, percent brown rice, percent total milled rice, and percent head rice for Tebonnet. Rice Research Station, Crowley, LA. 1985.

Source of variation	df	Harvest moisture	Percent brown rice	Percent total milled rice	Percent head rice
Rep	3	0.20	0.05	0.08	1.81
Harvest	9	78.07**	0.14**	9.23**	437.40**
Error	27	0.23	0.05	0.23	2.13
CV		22.26	0.31	2.21	18.40

**Significant at 0.01 probability level.

The greatest influence of harvest moisture versus milling yield was observed in the head rice yield. Mean head milling yield was 55.0% with a high of 61.5% and a low of 26.2%. Regression of percent head rice data as related to harvest moisture indicates maximum yield occurred when harvest moisture was near 21.0%. This area experienced about a week of rain starting August 9 and peaking with the passing of Hurricane Danny on August 15. There was a large reduction in head rice yield for the one harvest date, August 19, after the storm. The coefficient of determination for the percent head rice and harvest moisture was 0.24**.

CONCLUSION

Harvest moisture of Tebonnet rice appears to have very little effect on the percent of brown rice yield. There was no apparent change after being subjected to rain for a week and a hurricane.

The percent total milled rice showed similar results with the exception of a small decrease in yield when the harvest moisture was greater than approximately 21.0%.

The largest difference in yield was seen in the percent head yield as related to harvest moisture. Peak yield occurred when rice was harvested around 21.0% grain moisture. Head yield decreased drastically as a result of the storm. Additional data will be collected from the 1986 season.

RICE FERTILIZATION AND PLANT NUTRITION

NITROGEN REQUIREMENTS OF NEW RICE VARIETIES AND THE RELATIONSHIP BETWEEN Y-LEAF N AND GRAIN YIELDS^{1/}

(A Preliminary Report)

D.M. Brandon, P.K. Bollich, H.F. Morris,
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INTRODUCTION

Nitrogen (N) fertilization is required for profitable rice production on virtually 100% of the Louisiana rice acreage. Current costs associated with N fertilization of rice are approximately 21 million dollars annually. Returns to rice growers, however, are much greater than N costs when management practices are used that maximize N fertilizer efficiency. Nitrogen fertilizer efficiency is influenced by rate, placement and time of N application, rice variety, water management, and other factors.

Placement of an optimum N rate 2 to 4 inches in the soil within 1 week before permanently flooding usually results in maximum plant use efficiency in the water-seeded, permanently flooded cultural system. Broadcasting an optimum N rate on a dry soil surface just before permanently flooding rice usually results in maximum plant use efficiency in the dry-seeded cultural system. Correct estimation of the optimum preplant or preflood N rate is critical to avoid both excessive and suboptimum N rates. Split applications of N that consist of two-thirds of the total N preplant in water-seeded rice and preflood in dry-seeded rice followed by a topdressing of the remaining one-third N at the panicle initiation or panicle differentiation growth stage is almost as efficient as a single preplant or preflood application of total N. A basal N application sufficient to maintain normal growth and development through the tillering and panicle formation stages, however, is necessary for maximum yield and N fertilizer efficiency when the total N rate is split.

Rice varieties may differ in both the amount and time of N application required for maximum yield. Some varieties require relatively small amounts of N because of inherently efficient N utilization or because plant lodging, disease, or other factors limit their yield. Other varieties may require relatively high N fertility for maximum yield, but excessive N induces lodging and/or physiological problems that greatly decrease yield potential. Still

^{1/} Appreciation is expressed to the Louisiana Rice Research Board for its financial support of this research and to Buford Perry, East Carroll Parish for his cooperation and assistance in the north Louisiana experiments. The assistance of Parish Agents S.D. Weston and Galen Wilson, East Carroll Parish, in locating the northeast Louisiana experimental sites is greatly appreciated.

other rice varieties may require moderate to high N fertility for maximum yield but excessive N does not greatly alter yield potential. A desirable variety should be N responsive, producing high grain yields at moderate N levels and maintaining those yields even when excessively fertilized with N. Field research is needed continuously to determine the N requirements of new varieties and identify those varieties that are more efficient N users. Nitrogen management information must be developed and made available to growers when new rice varieties are released to permit efficient and profitable rice production.

Rice plant analysis that assays the N status of rice during the season may be a valuable guide for determining the total N requirements of a variety and midseason N needs of the growing crop. Limited rice plant analysis research indicates that 2.3 to 3.5% total N in the most recently matured rice leaf (Y-leaf) is required for maximum grain yield, depending on variety and plant growth stage. Continued research is needed to identify the critical Y-leaf N concentration at different plant growth stages for each commercial rice variety. Research is required also to develop rice tissue analysis as a diagnostic aid to determine midseason N requirements. A knowledge of critical N concentrations at different plant growth stages for different rice varieties should improve N fertilization efficiency by preventing both suboptimum and excessive N fertilization of rice.

Studies have been conducted since 1980 to determine the N requirements of most commercial rice varieties and advanced experimental lines in Louisiana. These studies were also designed to determine the relationship between Y-leaf N concentration at different growth stages and grain yields of each rice variety. Specific objectives were to:

1. Determine yield potential and agronomic performance of new rice varieties and experimental lines in different environments;
2. Determine the optimum N rate and time of application for each varietal entry;
3. Determine the relationship between plant tissue N and grain yields; and
4. Determine critical N concentrations in the Y-leaf at different growth stages and evaluate the feasibility of using Y-leaf N as a diagnostic aid to determine midseason N requirements.

MATERIALS AND METHODS

Three experiments were conducted in a Crowley silt loam soil at the Rice Research Station (RRS) and in a Sharkey clay soil on the Buford Perry Farm, East Carroll Parish. Soil chemical properties of the surface 4-inch soil profile depth in the experimental areas are shown in Table 1. The Crowley silt loam on the RRS was fallowed and leveled in 1984 after soybean production in 1983 and rice in 1982. The soil is relatively shallow with a clay pan at the 3- to 4-inch depth. The Sharkey clay soil was cropped to soybeans the previous 5 years before the 1985 season.

Table 1. Chemical properties of the Crowley silt loam, Sharkey clay, and Perry clay soils in the experimental areas. 1984.*

Chemical properties	Crowley silt loam*	Sharkey clay*
pH	6.2	6.1
Organic matter, %	.73	1.7
P, ppm	9	82
K, ppm	53	500
Ca, ppm	1503	4000
Mg, ppm	284	1000
Na, ppm	98	97
Zn, ppm	1.41	5.9

* Analytical methods presented in: Brupbacher, R.H., W.P. Bronner, and J.E. Sedberry, Jr. 1968. Analytical methods and procedures used in the soil testing laboratory. La. Agric. Exp. Stn. Bul. 632.

Twelve rice varieties and/or advanced experimental lines were grouped by maturity and grain type into three groups for testing purposes. The groups and varietal entries were:

1. Very early long-grain varieties: Labelle (LBLE), Bond, Tebonnet (TBNT), and L-202.
2. Early long-grain varieties: Lebonnet (LBNT), Leah, Gulfmont (GFMT), Lemont (LMNT), Skybonnet (SKBT), and TORO-2 (TRO2).
3. Midseason long-grain varieties: Starbonnet (STBT) and Newbonnet (NWBT).

Labelle is a tall long-grain variety that has rather low yield potential but is favored by growers because of its earliness and desirable ratoon characteristics. Bond is a long-grain variety developed in Arkansas. Bond has larger seed and has shown better seedling vigor and lodging resistance than Labelle. Bond has shown higher yield potential than Labelle consistently in previous rice fertilization tests, however, Bond will lodge when excessively fertilized with N. Tebonnet is a tall long-grain variety that has relatively strong straw strength. It has performed better than Labelle in the breeding nurseries and previous N tests. Tebonnet has yielded equal to Bond in previous N tests, but it required higher N rate for equal yield. L-202 is a new semi-dwarf, long-grain variety developed in California. It has shown exceptionally high yields in both experimental and commercial planting in California. L-202 was the highest yielding variety in this group in 1984.

The early long-grain varieties tested mature about the same time as Lebonnet. Leah, Lemont, Gulfmont, and TORO-2 are semidwarf, lodging resistant long-grain varieties that show very high yield potential. Lemont was developed in Texas and jointly released by Texas, Louisiana, and Mississippi in 1982. This is the first year that Gulfmont, a new semidwarf variety developed in Texas, has been tested in this project. Gulfmont is similar to Lemont in most characteristics, except it is 4 to 5 days earlier. Skybonnet, another new Texas variety, is similar to Lebonnet in height but is several days earlier

than Lebonnet in maturity. TORO-2 is a semidwarf, long-grain variety that has grain cooking characteristics like Toro. Toro and TORO-2 cook similar to medium grains because of low amylose content and a low gelatinization temperature.

The midseason long-grain variety Starbonnet was previously grown extensively in northeast Louisiana. It has moderate yield potential because of its lodging susceptibility. Newbonnet is a new Arkansas variety which is shorter in height, earlier in maturity, and has greater yield potential than Starbonnet. Newbonnet and Lemont has replaced the lodging susceptible Starbonnet in Louisiana. Newbonnet has yielded approximately 1000 lb/A more than Starbonnet in previous fertilization tests.

Nitrogen rates of 0, 30, 60, 90, 120, and 150 lb/A were band-placed with 60 lb/A P_2O_5 and K_2O into a smooth, friable seedbed 1 day before flooding the water-seeded experiments at the RRS. Ammonium sulfate was placed at a soil depth of 1 to 2 inches with a drill. The 90 lb N/A rate was also split to provide 60 lb N/A preplant plus 30 lb N/A hand-broadcast at panicle initiation (green ring) or panicle differentiation (panicle 2 mm) plant growth stages.

The northeast Louisiana experiments were drill-seeded. The same N rates, times, and source of N were used in these experiments, except the basal 30, 60, 90, 120, and 150 lb N/A rates were hand-broadcast on the soil surface 1 day before permanently flooding the drill-seeded rice. The experimental design was a split plot in a randomized complete block with four replications in all the experiments. Nitrogen treatments were assigned randomly to main plots and varieties to subplots. Individual plot size was 7 x 25 ft (175 ft²).

Presoaked seed of each variety was hand-broadcast into a shallow flood at a seeding rate of 150 lb/A in the water-seeded experiments at the RRS. The very early and early long-grain groups were seeded May 3 and April 12, 1985, respectively. The midseason long-grain group was seeded April 18. The experiments were flooded for 2 to 4 days after seeding, at which time they were drained for 2 to 4 days to encourage seedling anchorage. A permanent flood was reestablished 6 to 8 days after planting and maintained for the duration of the season. The soil was not allowed to dry during the brief drainage period.

The field experiments in northeast Louisiana were drill-seeded at a seeding rate of 100 lb/A. Experiments at the East Carroll Parish location were seeded May 7, 1985. The plantings were flushed May 14 to germinate the seed and reflushed May 21 and 25 to establish the rice stand. Seedlings emerged May 25, 1985 and two additional flushings were required before the permanent flood. The East Carroll Parish experiments were fertilized with N when the soil was dry June 5 and flooded permanently June 6, 1985. Weeds and insects were controlled by currently recommended practices in all experiments.

Plant tissue samples were collected from the RRS and East Carroll parish experiments to study the relationship between plant N and grain yield. Samples of the most recently matured rice leaves (Y-leaf), consisting of 50 leaves, were randomly collected from each plot at the mid-tillering, panicle initiation (PI), and panicle differentiation (PD) growth stages. Leaf samples were oven-dried 48 hours at 70°C. Total N (Kjeldahl) is being determined by the Soil and Plant Nutrition Laboratory at the RRS. An Orange G quick test for N is being done at the RRS to determine its relationship to Kjeldahl N. Analytical

results for 1985 are not completed but will be made available in a later report.

Individual whole plots were combine-harvested at field maturity. Agronomic variables measured were: Days to 50% heading, plant height, lodging, grain moisture, and grain yield.

RESULTS AND DISCUSSION

Experimental results are presented by varietal group. Influence of N rate and timing of agronomic performance of rice varieties at each location will be discussed in detail. A report on the relationship between Y-leaf N and grain yield will be written when analytical results are available.

VERY EARLY LONG-GRAIN RICE VARIETIES

Effect of N Rate and Time of Application on Agronomic Performance of Very Early Long-Grain Rice Varieties.

Seedling vigor of the very early long-grain rice varieties apparently was not influenced by N fertilizer rate in the water-seeded rice at Crowley. L-202 was slightly more vigorous than Tebonnet and Bond in the seedling stage but all varieties were more vigorous than Labelle. Labelle emerged from the water slowly and appeared weak, however, L-202, Tebonnet, and Bond emerged rather rapidly and were erect in seedling growth habit. All varieties showed slight N deficiency which slowed seedling growth before the permanent flood in the drill-seeded rice in East Carroll Parish. Preplant application of a small amount of N would have prevented this early N deficiency.

Maturity of the very early varieties was delayed approximately two days by an excessively high N rate of 150 lb/A when compared to the optimum 90 to 120 lb N/A rate in Crowley (Table 2) and 60 to 90 lb N/A rate in East Carroll Parish (Table 4). The severely N deficient rates of zero to 30 lb N/A in Crowley also delayed maturity. The optimum 90 to 120 lb/A in Crowley and 60 to 90 lb/A rate in East Carroll Parish favored earlier and more uniform grain maturity than either suboptimum or excessively high N rates. Split N applications resulted in fewer days to 50% heading than did a single preplant application of the total 90 lb N/A at both locations.

Plant height of all varieties increased greatly with increasingly higher N rates but the magnitude of the increase was greater in the tall varieties (Labelle, Bond, and Tebonnet) than in the semidwarf L-202 (Tables 3 and 5). Plants of all very early varieties were taller in northeast Louisiana (Table 5) than they were in southwest Louisiana (Table 3). All tall varieties (Labelle, Bond, and Tebonnet) lodged severely at excessively high N rates at both locations (Tables 3 and 5). The semidwarf L-202 did not lodge at either location. As in 1984, lodging was more severe in the water-seeded system at Crowley than in the drill-seeded system in East Carroll Parish. Split application of 90 lb N/A decreased plant height and lodging in relation to a single preplant application of the total N (Tables 3 and 5), but grain yields were also decreased in some varieties (Tables 2 and 4). The split N applications generally resulted in less efficient N use than a single preplant or pre-flood application because of early N deficiency that limited dry matter accumulation.

Table 2. Effect of N rate and time of application on maturity and grain yield of water-seeded very early long-grain rice varieties. Rice Research Station, Crowley, LA. 1985.

Total N	Time of N*			Days to 50% heading					Grain yield at 12% moisture				
	PP	PI	PD	L202	BOND	TBNT	LBLE	MEAN	LBLE	BOND	TBNT	L202	MEAN
-----lb/A-----				N**					N**				
0	--	--	--	71	74	75	75	73 ^{abc}	1620	2220	1800	2450	2020 ^a
30	30	--	--	69	70	72	74	71 ^a	3200	4050	3440	4290	3750 ^b
60	60	--	--	68	73	74	74	72 ^{ab}	4570	5250	5520	6020	5340 ^c
90	90	--	--	71	75	78	76	75 ^{bcd}	5540	6090	6120	7390	6290 ^{ef}
90	60	30	--	70	72	72	73	72 ^{ab}	5030	5560	5810	6130	5630 ^{cd}
90	60	--	30	70	74	75	75	73 ^{abc}	5200	5920	5930	6420	5870 ^{de}
120	120	--	--	71	76	77	78	75 ^{cd}	5600	6160	6370	7810	6490 ^f
150	150	--	--	73	78	79	79	79 ^d	5770	5620	6180	7520	6270 ^{ef}
Variety mean**				70 ^a	74 ^b	75 ^c	75 ^c		4570 ^a	5110 ^b	5150 ^b	6010 ^c	
C.V., %				2.16					4.75				

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

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

Table 3. Effect of N rate and time of application on plant height and lodging of water-seeded very early long-grain rice varieties. Rice Research Station, Crowley, LA. 1985.

Total N	Time of N*			Plant height					Lodging rate/type***				
	PP	PI	PD	LBLE	TBNT	BOND	L202	MEAN	BOND	TBNT	LBLE	L202	MEAN
-----lb/A-----				-----cm-----									
0	--	--	--	69	64	58	55	61 ^a	23/2	0/0	0/0	0/0	10 ^a /1 ^a
30	30	--	--	86	82	72	64	76 ^b	65/4	23/2	0/0	0/0	22 ^b /2 ^b
60	60	--	--	99	102	82	71	89 ^{cd}	88/5	48/3	20/2	0/0	39 ^c /3 ^{cd}
90	90	--	--	112	115	93	75	99 ^e	90/5	70/4	60/4	0/0	55 ^{cd} /4 ^{de}
90	60	30	--	100	105	84	74	83 ^c	88/5	73/5	10/1	0/0	42 ^c /3 ^{cd}
90	60	--	30	101	104	89	73	92 ^d	83/5	48/3	28/2	0/0	39 ^c /3 ^c
120	120	--	--	120	118	102	81	105 ^f	90/5	90/5	83/5	10/1	68 ^d /4 ^e
150	150	--	--	116	125	106	82	107 ^f	90/5	75/4	88/4	30/2	70 ^d /4 ^e
Variety mean**				100 ^a	98 ^b	86 ^a	72 ^c		77 ^a /4 ^a	53 ^b /3 ^b	35 ^c /2 ^c	10 ^d /1 ^d	
C.V., %				9.56					41.34				

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

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

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

Table 4. Effect of N rate and time of application on maturity and grain yield of drill-seeded very early long-grain rice varieties. Buford Perry Farm, East Carroll Parish, LA. 1985.

Total N	Time of N*			Days to 50% heading					Grain yield at 12% moisture				
	PF	PI	PD	N**				MEAN	N**				MEAN
-----lb/A-----				L202	LBL	BLE	TBNT	BOND	-----lb/A-----				
0	--	--	--	65	67	66	67	66 ^a	6170	7400	6770	6820	6790 ^{ab}
30	30	--	--	65	67	66	67	66 ^a	6680	7300	7720	7740	7360 ^{bc}
60	60	--	--	66	68	68	68	68 ^b	7370	7620	8570	8550	8030 ^d
90	90	--	--	68	70	70	70	69 ^c	7330	8190	9220	9020	8440 ^d
90	60	30	--	66	68	67	68	67 ^b	7500	8260	8660	8430	8210 ^d
90	60	--	30	65	69	68	68	67 ^b	7190	7840	8190	8410	7910 ^{cd}
120	120	--	--	69	70	72	71	71 ^d	6040	6020	8270	8560	7220 ^b
150	150	--	--	70	71	73	72	77 ^e	5290	4380	6840	8680	6300 ^a
Variety mean**				67 ^a	69 ^b	69 ^b	69 ^c		6700 ^a	7130 ^b	8030 ^c	8280 ^d	
C.V., %				1.05					5.89				

* Time of N: PF = preflood; PI = panicles initiation; PD = panicle differentiation.

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

Table 5. Effect of N rate and time of application on plant height and lodging of drill-seeded very early long-grain rice varieties. Buford Perry Farm, East Carroll Parish, LA. 1985.

Total	Time of N*				Plant height					Lodging rate/type***				
	N	PF	PI	PD	L202	BOND	TBNT	LBLE	MEAN	L202	TBNT	BOND	LBLE	MEAN
	-----lb/A-----				-----cm-----									
0	--	--	--	--	73	87	91	100	87 ^a	0/0	0/0	0/0	0/0	0 ^a /0 ^a
30	30	--	--	--	83	91	105	107	97 ^b	0/0	0/0	0/0	0/0	0 ^a /0 ^a
60	60	--	--	--	87	100	118	118	105 ^c	0/0	0/0	0/0	0/0	0 ^a /0 ^a
90	90	--	--	--	97	108	123	126	113 ^d	10/1	15/1	13/1	23/2	15 ^a /1 ^b
90	60	30	--	--	93	98	115	116	105 ^c	0/0	0/0	0/0	0/0	0 ^a /0 ^a
90	60	--	30	--	92	99	120	116	107 ^c	0/0	0/0	0/0	0/0	0 ^a /0 ^a
120	120	--	--	--	94	105	138	131	117 ^d	0/0	40/2	58/3	63/3	40 ^b /2 ^{bc}
150	150	--	--	--	102	112	137	133	121 ^e	10/1	78/3	70/3	68/3	56 ^b /2 ^c
Variety mean**					90 ^a	99 ^a	118 ^b	118 ^b		0 ^a /0 ^a	17 ^b /1 ^b	18 ^b /1 ^b	20 ^b /1 ^b	
C.V., %					4.59					89/108				

* Time of N: PF = preflood; PI = panicle initiation; PD = panicle differentiation.

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

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

Grain yields of very early rice varieties increased with increasingly higher N rates until the optimum was reached for a specific variety and then yields decreased with excessively high N rates (Tables 2 and 4). The semidwarf L-202 required slightly more N for optimum yield than did Labelle, Bond, and Tebonnet in Crowley, however, N requirement was similar in the more fertile Sharkey clay soil in East Carroll Parish. All varieties except Labelle required 90 lb N/A for maximum yield at the East Carroll Parish location. Labelle required only 60 lb N/A. Labelle, Bond, and Lebonnet required 90 lb N/A for optimum yield in the water-seeded system in Crowley, but L-202 required 120 lb N/A. These data clearly show only a moderate rate of N is required for optimum yield of these rice varieties when the crop is managed properly.

A single preplant 90 lb N/A rate in the water-seeded experiment (Table 2) and preflood 90 lb N/A rate in the drill-seeded experiment (Table 4) was generally more efficient than were split N applications. The single 90 lb N/A rate produced higher grain yields than did the split N applications in all varieties in Crowley (Table 2), but the split N applications resulted in slightly higher grain yield of Labelle in the Sharkey clay soil (Table 4) where the 90 lb N/A rate was excessively high for this variety. The split N rate of 60 lb N/A preplant, or preflood, plus 30 lb N/A at either panicle initiation or panicle differentiation resulted in plant N deficiency during the tillering to internode elongation stages which reduced the number of panicles, and subsequently, reduced grain yield. A comparison of the 60 lb N/A rate preplant, or preflood, with the split N rate of 90 lb N/A indicates that topdressed N was inefficiently utilized by rice in these experiments.

The average yield of Labelle, Bond, Tebonnet, and L-202 in Crowley were 4,570, 5,110, 5,150, and 6,010, respectively (Table 2). The average yield ranking at the East Carroll Parish location was identical to that in Crowley, however, grain yields were approximately 2,000 to 3,000 lb/A greater in East Carroll Parish (Table 4). L-202 and Tebonnet were more productive than Labelle and Bond at both suboptimum and excessively high N rates which may indicate that these new varieties tolerate a wider range of management conditions than do Labelle and Bond. Additional research is needed to determine the adaptability of the California variety L-202 to environmental and disease conditions in Louisiana. Results of these experiments show that application of an optimum N rate at the correct time and in combination with good management practices are critical to maximizing the performance of very early rice varieties.

EARLY LONG-GRAIN RICE VARIETIES

Effect of N Rate and Time of Application on the Performance of Early Long-Grain Rice Varieties.

Seedling vigor of early long-grain rice varieties was not influence by N treatments in the water-seeded experiment in Crowley. Seedlings of all varieties emerged through the water before N deficiency began to show in the zero N treatments. Nitrogen deficiency symptoms were visible in the drill-seeded experiment in East Carroll Parish before the permanent flood. The early N deficiency slowed seedling growth of all varieties in the drill-seeded rice which had received no preplant N. Skybonnet and Lebonnet showed slightly less seedling vigor than Leah, Lemont, Gulfmont, and TORO-2 in the water-seeded experiment in Crowley but no varietal seedling vigor differences were observed in the drill-seeded experiment in East Carroll Parish.

Nitrogen rate and time of application influenced maturity, plant height, and lodging. Increasingly higher N rates generally increased the number of days to 50% heading (Tables 6 and 8) and plant height (Tables 7 and 9) of all varieties in this group. Lemont was the latest maturing variety in this group at the East Carroll Parish location, however, Leah was the latest maturing in Crowley. Gulfmont was 2 to 3 days earlier than Lemont as expected. Plant height increase of the tall varieties Lebonnet and Skybonnet was greater than that of the semidwarf varieties Lemont, Gulfmont, Leah, and TORO-2 with increasingly higher N rates (Tables 7 and 9). The number of days to 50% heading was less and plant height was greater at the East Carroll Parish location than at the Crowley location. Lodging rate and severity of the tall Lebonnet and Skybonnet, and semidwarfs Leah and TORO-2, increased greatly in East Carroll Parish where excessively high N rates were applied (Table 9). The semidwarfs Lemont and Gulfmont did not lodge at excessively high N rates. The only lodging of any consequence in Crowley occurred only where excessively high N rates were applied to Lebonnet (Table 7). Split N application generally decreased the number of days to 50% heading, plant height, and lodging, however, grain yields also were reduced where the 90 lb N/A rate was suboptimum. The split application of 90 lb N/A increased yields when the 90 lb N/A was excessively high for a particular variety.

Grain yields of early long-grain varieties were maximized generally by a single preplant or preflood application of 60 to 150 lb N/A (Tables 6 and 8). The optimum N rate, however, was dependent on variety and location. The semidwarf varieties Lemont, Gulfmont, Leah, and TORO-2 and tall Skybonnet required 150 lb N/A for maximum yields in Crowley (Table 6) but only 30 to 90 lb N/A was required in the fertile Sharkey clay soil in East Carroll Parish (Table 8). Lebonnet required 120 lb N/A in Crowley and only 30 lb N/A in East Carroll Parish. The relatively low fertilizer N rate required in the Sharkey clay soil was probably due to native N that accumulated during the previous years when this field was in soybeans. The relatively high N requirement in Crowley was unusual compared to previous years and may have resulted from loss of some fertilizer N during the early drainage of this experiment. The semidwarf rice varieties generally yielded much greater than the tall varieties when excessively high N rates were applied. Excessive N did not induce severe lodging of semidwarf varieties, but it did induce severe lodging of tall varieties. Split N applications of 90 lb N/A resulted in lower yields than a single preplant application of 90 lb N/A in Crowley because the 90 lb N/A rate was suboptimum (Table 6). Nitrogen deficiency reduced early plant tillering and the number of grains per panicle, and subsequently, grain yields, because the 60 lb N/A was not sufficient to optimize vegetative growth during the period of tillering to panicle initiation. Severe N deficiency during this growth interval usually limits yield potential even though high rates of N were applied later. Nitrogen deficiency during tillering to panicle initiation should be avoided because of its severe reduction of yield potential.

The new semidwarf varieties Lemont and Gulfmont were well adapted to both locations. Lemont and Gulfmont yielded significantly greater than tall varieties at both locations, especially when near optimum N rates were applied. Maximum grain yields of Lemont and Gulfmont in Crowley were 8,800 and 8,660 lb/A, respectively. Maximum grain yield of Lemont and Gulfmont at the East Carroll Parish site were 9,490 and 9,370 lb/A, respectively. Grain yields of the semidwarf varieties were depressed only slightly by excessively high N

Table 6. Effect of N rate and time of application on maturity and grain yield of drill-seeded early long-grain rice varieties. Rice Research Station, Crowley, LA. 1985.

Total		Time of N*			Days to 50% heading							Grain yield @ 12% moisture							N**			
		PP	PI	PD	LBNT	SKBT	GFMT	TOR2	LMNT	LEAH	MEAN	LBNT	SKBT	TOR2	GFMT	LEAH	LMNT	MEAN				
-----lb/A-----		-----lb/A-----																				
0	--	--	--	--	81	80	84	88	88	92	85 ^a	2180	2260	2040	2390	2560	2430	2310 ^a				
30	30	--	--	--	78	77	81	82	82	86	81 ^{cd}	3530	3230	3830	3280	3740	3070	3450 ^b				
60	60	--	--	--	77	77	81	81	83	84	81 ^{cd}	4810	5230	5570	5360	5550	6020	5420 ^c				
90	90	--	--	--	78	78	83	82	84	84	82 ^c	6420	6670	6940	7070	7190	7360	6940 ^d				
90	60	30	--	--	77	77	80	81	82	84	80 ^{cd}	5630	5390	5960	5760	5920	6020	5780 ^d				
90	60	--	30	--	77	78	82	80	83	85	81 ^{cd}	5310	5300	5675	5630	5970	5880	5630 ^d				
120	120	--	--	--	78	81	84	85	85	85	83 ^b	7060	7630	7380	8000	7510	8180	7710 ^f				
150	150	--	--	--	79	82	84	85	85	86	84 ^b	6150	8500	8250	8660	7820	8800	8030 ^e				
Variety mean**		78 ^a	79 ^b		84 ^e	86 ^f	83 ^d	82 ^c	83 ^d	84 ^e	86 ^f	5130 ^a	5530 ^b	5770 ^c	5770 ^c	5780 ^c	5970 ^d					
C.V., %		1.48										4.51										

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

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

Table 7. Effect of N rate and time of application on plant height and lodging of water-seeded early long-grain rice varieties. Rice Research Station, Crowley, LA. 1985.

Total N	Time of N*			Plant height							Lodging rate/type***							N** MEAN
	PP	PI	PD	LMNT	GFMT	LEAH	TOR2	SKBT	LBNT	LMNT	GFMT	LEAH	TOR2	SKBT	LBNT			
	-----lb/A-----			-----cm-----														
0	--	--	--	58	62	63	65	69	69	64 ^a	0/0	0/0	0/0	0/0	0/0	0/0	0 ^a /	
30	30	--	--	60	60	66	70	74	76	68 ^b	0/0	0/0	0/0	0/0	0/0	0/0	0 ^a /	
60	60	--	--	69	70	79	83	88	85	79 ^c	0/0	0/0	0/0	0/0	0/0	0/0	0 ^a /	
90	90	--	--	75	77	88	90	98	103	89 ^d	0/0	0/0	0/0	0/0	0/0	0/0	0 ^a /	
90	60	30	--	71	71	81	85	89	91	81 ^c	0/0	0/0	0/0	0/0	0/0	0/0	0 ^a /	
90	60	--	30	70	72	79	85	87	89	80 ^c	0/0	0/0	0/0	0/0	0/0	0/0	0 ^a /	
120	120	--	--	82	84	97	102	109	112	98 ^e	0/0	0/0	0/0	0/0	0/0	23/1	0 ^a /	
150	150	--	--	84	87	103	105	116	115	102 ^f	0/0	0/0	0/0	10/1	0/5	60/3	10 ^b /1	
Variety mean**				71 ^a	73 ^b	82 ^c	85 ^d	91 ^e	92 ^e		0 ^a /0	0 ^a /0	0 ^a /0	0 ^a /0	0 ^a /0	10 ^b /1		
C.V., %				3.45							340/245							

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

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

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

Table 8. Effect of N rate and time of application on maturity and grain yield of drill-seeded early long-grain rice varieties. Buford Perry Farm, East Carroll Parish, LA. 1985.

Total N	Time of N*			Days to 50% heading						Grain yield @ 12% moisture						N** MEAN	
	PF	PI	PD	SKBT	LEAH	TOR2	LBNT	GFMT	LMNT	LEAH	LMNT	GFMT					
	lb/A			lb/A						lb/A							
0	--	--	--	70	73	72	72	72	76	73 ^b	7730	7470	7160	7720	8110	7840	7670 ^a
30	30	--	--	71	72	71	72	71	74	72 ^a	8570	8410	8360	8320	9250	9010	8650 ^b
60	60	--	--	71	72	72	72	72	75	72 ^{ab}	8590	8760	8880	8870	9060	9120	8870 ^b
90	90	--	--	73	73	73	73	73	76	73 ^c	8100	8210	8960	8660	9070	9210	8700 ^b
90	60	30	--	71	72	72	71	72	75	72 ^{ab}	8730	8120	8620	8620	9020	9030	8690 ^b
90	60	--	30	71	72	72	72	72	74	72 ^{ab}	8390	8630	8740	8730	9490	9310	8880 ^b
120	120	--	--	74	73	74	74	75	79	75 ^d	6810	8350	8420	8830	9150	9370	8490 ^b
150	150	--	--	75	75	76	76	76	79	76 ^e	6550	7480	7470	7950	8810	9250	7920 ^a
Variety mean**				72 ^a	73 ^b	73 ^{bc}	73 ^d	73 ^d	76 ^d		7950 ^a	8180 ^b	8330 ^{bc}	8450 ^c	9000 ^d	9020 ^d	
C.V., %																	4.46
																	0.99

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

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

Table 9. Effect of N rate and time of application on plant height and lodging of drill-seeded early long-grain rice varieties. Buford Perry Farm, East Carroll Parish, LA. 1985.

Total N	Time of N*			Plant height					Lodging rate/type***							N**	
	PF	PI	PD	LMNT	GFMT	LEAH	TOR2	SKBT	LBNT	LMNT	GFMT	LEAH	SKBT	TOR2	LBNT	MEAN	
	lb/A			cm												MEAN	
0	--	--	--	76	77	81	88	95	103	87 ^a	0/0	0/0	0/0	0/0	0/0	0/0	0 ^a /0
30	30	--	--	85	86	94	93	108	109	96 ^{ab}	0/0	0/0	0/0	0/0	0/0	0/0	0 ^a /0 ^a
60	60	--	--	84	87	96	100	106	113	99 ^b	0/0	0/0	0/0	0/0	0/0	0/0	0 ^a /0 ^a
90	90	--	--	90	87	102	105	119	125	105 ^{bc}	0/0	0/0	0/0	0/0	0/0	45/2	10 ^a /0 ^a
90	60	30	--	87	85	95	95	109	115	98 ^b	0/0	0/0	0/0	0/0	0/0	0/0	0 ^a /0 ^a
90	60	--	30	86	89	97	103	112	115	100 ^b	0/0	0/0	0/0	0/0	0/0	18/2	0 ^a /0 ^a
120	120	--	--	94	97	113	113	125	130	112 ^c	0/0	0/0	10/1	40/3	78/3	22 ^b /1 ^b	
150	150	--	--	98	97	112	111	127	134	113 ^c	0/0	0/0	23/3 ^a	63/3	80/3	33 ^b /2 ^c	
Variety mean**				87 ^a	88 ^a	99 ^b	101 ^b	113 ^c	118 ^d		0 ^a /0 ^a	0 ^a /0 ^a	0 ^b /1 ^b	13 ^c /1 ^b	27 ^d /1 ^b		
C.V., %				117/105													
				4.93													

* Time of N: PF = preflood; PI = panicle initiation; PD = panicle differentiation.

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

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

rates because of their lodging resistance however, tall Lebonnet yields were severely depressed because of lodging.

MIDSEASON LONG-GRAIN RICE VARIETIES

Effect of N Rate and Time of Application on Performance of Midseason Long-Grain Rice Varieties.

The midseason varieties were generally more vigorous than other long-grain varieties in the seedling stage of growth. The commercial varieties Starbonnet and Newbonnet emerged rapidly in both the water- and drill-seeded experiments at the Crowley and East Carroll Parish locations, respectively. The experimental semidwarf LA 71 showed seedling vigor comparable to Starbonnet and Newbonnet in the water-seeded experiment in Crowley.

Maturity of the midseason long-grain rice varieties was enhanced by increasingly higher N rates in Crowley (Table 10). Maturity was not affected by N at the East Carroll Parish location (Table 11). Plant lodging of Starbonnet and Newbonnet increased greatly with increasingly higher N rates but the semidwarf experimental LA 71 did not lodge in Crowley (Table 12). Starbonnet lodged at excessively high N rates in East Carroll Parish but Newbonnet did not lodge (Table 11). Newbonnet was 12 to 16 cm shorter than Starbonnet (Tables 11 and 12).

Newbonnet and LA 71 were more N responsive than Starbonnet (Tables 10 and 11). Newbonnet required 60 and 150 lb N/A for maximum grain yield at the East Carroll Parish and Crowley locations, respectively. Starbonnet required only 60 to 90 lb N/A for maximum yield at both locations. Newbonnet has consistently required about 30 lb N/A more than Starbonnet for maximum yield in previous experiments. Newbonnet produced relatively high yields at suboptimum and excessive N rates, however, grain yield of Starbonnet was severely reduced at excessively high N because of lodging. Split N applications of the 90 lb N/A rate reduced grain yield when compared to a single preplant application of 90 lb N/A in Crowley (Table 10) because the 60 lb N/A preplant was not sufficient to prevent N deficiency before panicle initiation. Conversely, the split N application resulted in slightly higher yield than a single preflood 90 lb N/A application in East Carroll Parish (Table 11) because the 90 lb N/A rate was excessively high in this Sharkey clay soil. These data generally indicate that a single preplant application in water-seeded rice, or preflood in drill-seeded rice, is superior to split N applications when the total N requirement is known. Topdressed N should be used only to supplement preplant or preflood N when insufficient amounts are applied preplant or preflood.

Newbonnet produced significantly higher grain yields than Starbonnet at both suboptimum and excessively high N rates at both locations (Tables 10 and 11). Newbonnet yielded approximately 1,500 lb/A more than Starbonnet where optimum N rates were used for both varieties. The experimental semidwarf LA 71 was the highest yielding variety in this group at its optimum N rate in Crowley. Newbonnet has consistently yielded greater than Starbonnet in 4 test years at the Crowley and East Carroll Parish locations. Newbonnet has performed comparably to Lemont based on grain yields. Newbonnet will lodge with high winds and rain, however, and Lemont performs much better under these conditions.

Table 10. Effect of N rate and time of application on maturity and grain yield of water-seeded midseason long-grain rice varieties. Rice Research Station, Crowley, LA. 1985.

Total N	Time of N*			Days to 50% heading				Grain yield at 12% moisture			
	PP	PI	PD	NWBT	LA71	STBT	N** MEAN	STBT	LA71	NWBT	N** MEAN
-----lb/A-----								-----lb/N-----			
0	--	--	--	90	88	95	91 ^d	2720	2720	2700	2710 ^a
30	30	--	--	87	88	94	90 ^c	3700	3720	4000	3810 ^b
60	60	--	--	85	87	92	88 ^{bc}	4980	5570	5350	5300 ^c
90	90	--	--	84	87	91	87 ^a	6180	7050	7260	6830 ^e
90	60	30	--	85	87	92	88 ^a	5780	5570	5770	5710 ^c
90	60	--	30	84	86	92	87 ^a	5910	6300	6370	6190 ^d
120	120	--	--	84	87	92	88 ^{ab}	6120	7030	7570	6900 ^e
150	150	--	--	85	87	93	88 ^b	5610	8340	7820	7260 ^e
Variety mean**				85	87	93		5120 ^a	5790 ^b	5850 ^c	
C.V., %				1.10				5.94			

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

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

Table 11. Effect of N rate and time of application on performance of drill-seeded midseason long-grain rice varieties. Buford Perry Farm, East Carroll Parish, LA. 1985.

Time of N*				Days to 50% heading			Plant height			% Lodging/type***			Grain yield at 12% moisture			
Total				N**			N**			N**			N**			
N	PF	PI	PD	NWBT	STBT	MEAN	NWBT	STBT	MEAN	NWBT	STBT	MEAN	STBT	NWBT	MEAN	
-----lb/A-----				-----cm-----			-----lb/A-----									
0	--	--	--	77	85	81 ^{bc}	100	113	106 ^a	0/0	0/0	0 ^a /0 ^a	7620	8320	7970 ^a	
30	30	--	--	77	83	80 ^a	104	120	112 ^b	0/0	0/0	0 ^a /0 ^a	8150	9110	8630 ^{bc}	
60	60	--	--	76	83	79 ^a	110	126	118 ^c	0/0	0/0	10 ^{ab} /1 ^{ab}	8370	9770	9070 ^{cd}	
90	90	--	--	77	83	80 ^a	113	131	122 ^d	0/0	0/0	0 ^a /0 ^a	8300	9850	9080 ^{cd}	
90	60	30	--	76	83	80 ^a	110	130	120 ^{cd}	0/0	0/0	0 ^a /0 ^a	8490	9550	9020 ^d	
90	60	--	30	76	83	79 ^a	115	129	122 ^d	0/0	0/0	0 ^a /0 ^a	8460	9820	9140 ^d	
120	120	--	--	77	84	81 ^b	120	135	127 ^e	0/0	28/3	14 ^{ab} /1 ^b	7430	9640	8530 ^b	
150	150	--	--	78	85	82 ^c	120	137	129 ^e	0/0	43/3	23 ^b /2 ^{bc}	6700	9360	8030 ^a	
Variety mean**				77 ^a	84 ^b		111 ^a	127 ^b		0 ^a /0 ^a	10 ^a /1 ^b		7930 ^a	9430 ^b		
C.V., %				0.99			3.49			241/182			4.12			

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

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

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

Table 12. Effect of N rate and time of application on plant height and lodging of water-seeded midseason long-grain rice varieties. Rice Research Station, Crowley, LA. 1985.

Total N	Time of N*			Plant height				Lodging rate/type***			
	PP	PI	PD	LA71	NWBT	STBT	N** MEAN	LA71	STBT	NWBT	N** MEAN
-----lb/A-----				-----cm-----							
0	--	--	--	56	63	71	63 ^a	0/0	0/0	0/0	0 ^a /0 ^a
30	30	--	--	59	71	77	69 ^b	0/0	0/0	0/0	0 ^a /0 ^a
60	60	--	--	69	78	88	79 ^c	0/0	10/2	38/3	20 ^b /2 ^b
90	90	--	--	76	83	101	87 ^d	0/0	58/5	78/5	45 ^c /3 ^{cd}
90	60	30	--	70	79	91	80 ^c	0/0	13/3	73/4	28 ^b /3 ^{bc}
90	60	--	30	70	83	91	81 ^c	0/0	15/2	88/5	34 ^{bc} /2 ^{bc}
120	120	--	--	79	93	107	93 ^e	0/0	90/5	90/5	61 ^d /3 ^d
150	150	--	--	84	99	115	99 ^f	0/0	90/5	90/5	62 ^d /4 ^d
Variety mean**				70 ^a	81 ^b	93 ^c		0 ^a /0 ^a	34 ^b /3 ^b	57 ^c /3 ^b	
C.V., %				3.72				37/32			

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

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

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

SUMMARY AND CONCLUSIONS

Six field experiments were conducted to determine the N requirements of new rice varieties and experimental lines in Crowley and East Carroll Parish. The experimental results will be used to determine the relationship between Y-leaf N and grain yields of 13 rice varieties when plant analyses are completed. Nitrogen in the plant will be determined by both the Kjeldahl and Orange-G dye methods to assess the validity of the Orange-G dye quick test procedure. The plant analysis component of these studies will be reported later because analytical results are not presently available.

The very early semidwarf L-202 and tall Tebonnet varieties required about 30 lb N/A more than Labelle and Bond for maximum yields in Crowley. Nitrogen requirement of all the very early varieties except Labelle was 90 lb N/A in the more fertile Sharkey clay soil in East Carroll Parish. The tall varieties Labelle, Bond, and Tebonnet lodged severely at both locations when excessive N was applied but the semidwarf L-202 did not lodge. L-202 and Tebonnet performed very well in these studies but additional research is required to determine the adaptation of L-202 to Louisiana.

The semidwarf, early long-grain varieties Lemont, Gulfmont, Leah, and TORO-2 were more N responsive than were the tall varieties Lebonnet and Skybonnet. Lemont, Gulfmont, TORO-2, Leah, and Skybonnet required about 60 lb N/A more than Lebonnet for maximum yield in Crowley, however, all varieties required only 30 to 60 lb N/A at the East Carroll Parish location. The semidwarfs performed equivalent to or greater than tall varieties at very low to suboptimum N rates. Grain yields of Lemont, Gulfmont, Leah, and TORO-2 were more stable over N rates and locations than were those of tall, lodging susceptible varieties. Lemont and the new semidwarf Gulfmont performed similarly at both locations, except Gulfmont was about 3 days earlier than Lemont. Split N applications generally did not increase yields over that of a single preplant or preflood N application. Conversely, grain yields were usually depressed by split N applications. Lemont has consistently performed very well in these tests over the past 5 years. The new earlier semidwarf Gulfmont performed very well in 1985 but additional studies should be done to determine its adaptation to Louisiana.

The midseason long-grain variety Newbonnet was shorter, earlier maturing, more resistant to lodging, and more productive than Starbonnet. Newbonnet required slightly more N than Starbonnet for maximum yield, but Newbonnet consistently produced 1,500 lb/A more than Starbonnet. The experimental variety LA 71 was more lodging resistant and more productive than Newbonnet and Starbonnet in Crowley. LA 71 was the highest yielding variety in this maturity group in Crowley.

The availability of new lodging resistant rice varieties has greatly increased the yield potential of rice in Louisiana. Four years of research with Lemont shows this plant type to have excellent lodging resistance and yield stability at high levels over a wide range of conditions. The new, earlier Gulfmont may perform equal to Lemont, but additional studies are needed to determine its adaptation. The semidwarf Lemont has yielded an average of approximately 8,000 and 9,000 lb/A when properly managed in southwest and northeast Louisiana, respectively. Although Lemont yields have been exceptionally high at N rates of 120 to 150 lb N/A, it has yielded equal to or

greater than tall varieties at low to moderate N levels. These data indicate that Lemont does not require exceptionally high N rates for optimum yields when the N is properly applied and the crop properly managed. Newbonnet has yielded equal to Lemont generally in the absence of lodging. Although Newbonnet is not a semidwarf, it has good lodging resistance. Newbonnet requires about the same N fertility level as Lemont for optimum grain yields.

EFFECT OF N RATE AND TIME OF APPLICATION ON PERFORMANCE OF^{1/}
SELECTED RICE VARIETIES AT DIFFERENT LOCATIONS IN LOUISIANA^{1/}

(A Preliminary Report)

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

INTRODUCTION

Extensive research designed to determine the optimum N rate and time of application for new rice varieties and experimental lines is conducted annually at the Rice Research Station (RRS) and in northeast Louisiana. The data base developed from this research is currently used to make N recommendations in the major rice growing areas of Louisiana. Experimental results developed at the RRS and in northeast Louisiana, however, may not be applicable to surrounding geographical areas because of environmental and soil differences that exist.

Five off-station field experiments were conducted in 1985 to monitor N requirements of selected rice varieties in locations other than the RRS and the Buford Perry Farm in northeast Louisiana. Field sites were selected on the basis of soil type and/or environment. These studies were conducted to determine the validity of results developed at the former locations to broader rice growing areas in Louisiana.

MATERIALS AND METHODS

Field experiments were conducted on the Errol Lounsberry Farm near Lake Arthur, LA (Vermilion Parish), the Will Bollich Farm near Cheneyville, LA (Rapides Parish), and on the Larry Tubbs Farm near Mer Rouge, LA (Morehouse Parish). Soil chemical properties at each site are shown in Table 1.

The three soils used in these studies differed from the Crowley silt loam soils at the RRS in Crowley. The Crowley silt loam in Vermilion Parish had a lower pH, higher organic matter, and higher extractable nutrient concentration (Table 1) than the RRS soil. The Moreland clay and Perry clay soils had a lower and higher pH, respectively, than the Sharkey clay soil in northeast Louisiana. Extractable nutrient concentrations in the Moreland clay and Perry clay soils were similar to those in the Sharkey clay.

Several commercial rice varieties and the new Gulfmont variety were used in these studies. Rice varieties used in the various locations were: Vermilion Parish - Mars, Lemont (LMNT), Newbonnet (NWBT), and Gulfmont (GFMT); Rapides Parish - Lebonnet (LBNT), Lemont, Newbonnet, and Gulfmont; and Morehouse Parish - Labelle (LBLLE), Bond, Tebonnet (TBNT), L-202, Lebonnet, Leah, Lemont, Starbonnet (STBT), and Newbonnet. A single experiment was conducted in Vermilion and Rapides Parish but the varieties in Morehouse Parish were grouped by maturity into three different experiments.

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

Table 1. Chemical properties of soils at selected experimental sites. 1985*

Experimental site	pH	OM -%-	Extractable nutrients					
			P	K	Ca	Mg	Na	Zn
			-----ppm-----					
Vermilion Parish (Crowley silt loam)	5.2	1.15	20	47	1192	188	54	2.39
Rapides Parish (Moreland clay)	7.1	2.13	145	500	4000	1000	44	3.77
Morehouse Parish (Perry clay)	5.9	2.27	95	500	4000	1000	133	5.86

* Analytical methods In: Brupbacher, R.H., W.P. Bonner, and J.E. Sedberry, Jr. 1968. Analytical methods and procedures used in the soil testing laboratory. Louisiana Agri. Exp. Stn. Bull. 632.

Nitrogen rates of 0, 30, 60, 90, 120, and 150 lb/A were band-placed within 7 days before flooding in the water-seeded cultural systems used in Vermilion and Morehouse Parishes. Ammonium sulfate or urea was used as the N source. The 90 lb N/A rate was also split to provide 60 lb N/A preplant plus 30 lb N/A at panicle initiation (PI) or panicle differentiation (PD) growth stages.

The experiments in Vermilion and Morehouse Parishes were water-seeded and the experiment in Rapides Parish was drill-seeded. The same N rates and times of application were used in the three locations, except the basal 30, 60, 90, 120, and 150 lb N/A rates were broadcast on the soil surface with a precision applicator 1 day before permanently flooding in Rapides Parish. The experimental design was a split plot in a randomized complete block with four replications. Nitrogen treatments were assigned randomly to main plots and varieties to subplots. Individual plot size was 7 x 25 ft (175 ft²).

Presoaked seed of each variety was hand-broadcast into a shallow flood at 150 lb/A in the water-seeded experiments in Vermilion and Morehouse Parishes. Dry seed was drill-seeded at 100 lb/A in the Rapides Parish experiment. This drill-seeded experiment was flushed with water immediately to initiate seed germination. The Vermilion experiment was seeded March 20, 1985 and was drained temporarily March 27 to enhance stand establishment. This experiment was reflooded March 29 and the rice emerged through the water April 6. The drill-seeded experiment in Rapides Parish was seeded April 20, 1985 and flushed two times to establish a rice stand. The rice emerged April 30 and was permanently flooded May 22 after propanil application. The water-seeded experiments in Morehouse Parish were seeded May 16, 1985 and was temporarily drained May 20 to enhance stand establishment. The experiment was reflooded May 23 and the rice emerged through the water May 29. Commercial pest control practices were used in all experiments.

The Vermilion Parish experiment was second cropped (ratooned) to study the performance of varieties and the influence of first crop N on second crop performance. The first crop was harvested July 28, 1985, and all plots cut to

a uniform stubble height of approximately 12 inches. A second crop N rate of 60 lb/A was broadcast on the dry soil and the experiment immediately reflooded to a shallow depth. The second crop was harvested November 5, 1985.

Whole plots were combine-harvested at maturity. Agronomic variables measured were days to 50% heading, plant height, lodging, grain moisture, and grain yield.

RESULTS AND DISCUSSION

The experimental results of these experiments are presented by location because environmental conditions were different among the locations. Results will be compared to those at the RRS when appropriate to evaluate the validity of extrapolation of results to other rice growing areas of Louisiana.

Effect of N Rate and Time of Application to the First Crop on First and Second Crop Performance of Selected Varieties in Vermilion Parish.

All varieties showed relatively strong seedling vigor in the water-seeded system used at the Vermilion Parish location. The order of varietal emergence through the 2- to 6-inch water depth was of the order Mars > Newbonnet > Lemont = Gulfmont. The four varieties had emerged and established a strong stand 16 days after planting.

Nitrogen deficiency symptoms were prevalent in the zero N treatments 35 days after seeding. Nitrogen deficiency symptoms are usually visible on the RRS 18 to 25 days after planting. Apparently this Crowley silt loam soil in Vermilion Parish had a higher native N level than the Crowley silt loam on the RRS, and consequently, N deficiency symptoms did not show as early as on the RRS. The soil analysis data (Table 1) showed that this Crowley silt loam soil had a much higher organic matter content than the same soil type on the RRS. The higher fertility level probably delayed N deficiency symptoms in relation to the RRS.

Maturity of the four varieties was slightly delayed by excessively high N rates as expected (Table 2). Plant height of all varieties increased significantly with increasingly higher N rates (Table 2) but the semidwarf varieties Lemont and Gulfmont did not respond as greatly to N as did the tall Newbonnet and Mars varieties. Lemont and Gulfmont were approximately 20 cm shorter than Newbonnet and Mars. Mars lodged severely at moderate to excessive N rates but the other varieties did not lodge.

The effect of first crop N rate and time of application on first crop grain yield is shown in Table 3. The optimum N rate depended on rice variety. Mars required 60 to 90 lb N/A for maximum yield while Lemont, Gulfmont, and Newbonnet required 90 to 120 lb N/A. Suboptimum N rates severely reduced first crop yields of the semidwarfs Lemont and Gulfmont but the yields of the tall Newbonnet and Mars were not as severely reduced by suboptimum N rates. Excessively high N rates of 120 to 150 greatly reduced the first crop yields of Mars because of lodging. Split N applications of 60 lb N/A preplant followed by a 30 lb N/A topdressing at panicle initiation or panicle differentiation generally increased first crop yields of Mars, Lemont, and Newbonnet in relation to a single preplant 90 lb N/A rate. Split N applications have usually reduced grain yields below that of a single preplant N application on the RRS,

Table 2. Effect of N rate and time of application on maturity and plant height of rice varieties in the water-seeded system. Errol Lounsberry Farm, Vermilion Parish, LA. 1985.

Total N	Time of N*			Days to 50% heading					Plant height				N** MEAN	
	PP	PI	PD	GFMT	LMNT	MARS	NWBT	MEAN	LMNT	GFMT	NWBT	MARS		
-----lb/A-----														
0	--	--	--	84	85	89	92	88 ^a	59	59	77	79	68 ^a	
30	30	--	--	85	86	89	91	87 ^a	63	70	83	87	76 ^{ab}	
60	60	--	--	85	88	89	91	88 ^{ab}	69	72	91	92	81 ^{bc}	
90	90	--	--	87	89	89	92	89 ^c	75	89	95	98	93 ^e	
90	60	30	--	86	87	90	91	88 ^b	75	74	91	94	84 ^{bcd}	
90	60	--	30	85	87	90	91	88 ^{ab}	70	71	90	98	82 ^{bc}	
120	120	--	--	87	90	92	93	90 ^d	78	80	98	99	88 ^{cde}	
150	150	--	--	89	92	95	95	93 ^e	78	83	101	99	90 ^{de}	
Variety mean**				86 ^a	88 ^b	90 ^c	92 ^d		71 ^a	76 ^b	91 ^c	93 ^c		
C.V., %				0.93					11.9					

* 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.

especially when the preplant 60 lb N/A was not sufficient to prevent N deficiency before panicle initiation. The split N application reduced lodging of Mars as compared to a single 90 lb N/A preplant application and this reduction in lodging may have been responsible for the higher yields in the split N treatments. Lemont and Newbonnet yields were affected less than those of Mars by time of N application. Newbonnet produced the highest first crop grain yields followed by Lemont, Gulfmont, and Mars (Table 3).

The effect of first crop N on the second crop grain yield of these varieties is shown in Table 3. Mars, Lemont, and Gulfmont produced exceptionally high second crop yields, however, the second crop of Newbonnet did not mature. The slow rate of regrowth and lateness of the second crop of Newbonnet made this variety unacceptable for second cropping (ratooning).

Regrowth of the second crop from first crop stubble was influenced by first crop N rate. Regrowth generally was more rapid in low first crop N rates than in moderate to excessively high N rates. Regrowth was more rapid in the low first crop N rates probably because a higher concentration of carbohydrate reserve was retained in the stubble of low first crop N treatments where the rice suffered from severe N deficiency. The lower grain yields in the 0 to 30 lb N/A rates probably resulted in higher carbohydrate levels in the stubble. Conversely, the higher first crop yields associated with moderate to high N rates probably depleted the carbohydrate reserve in the stubble of these N treatments and reduced the regrowth rate.

The second crop yields of Mars, Lemont, and Gulfmont were enhanced by optimum N rates in the first crop (Table 3). Mars, Lemont, and Gulfmont required 60, 90, and 90 lb N/A, respectively, for optimum first crop yields and these same treatments produced near maximum second crop yields. Analysis of the total crop yield (first and second crop) shows clearly that optimum N management in the first crop resulted in high yields of the second crop and that the first crop yield was much greater than that of the second crop (Table 3). The total yields by variety was of the order Lemont > Gulfmont > Mars > Newbonnet. The total average rice yields were 11,210, 10,370, 9,580, and 7,830 lb/A for Lemont, Gulfmont, Mars, and Newbonnet, respectively (Table 3). These data clearly showed that optimum N management in the first crop favored optimum regrowth and grain yields of the second crop. These data indicate that growers should strive for optimum first crop yield because the first crop produces a much greater part of the total yield than the second crop. Moreover, weather and field conditions may not be conducive to good second crop yields in some years.

Effect of N Rate and Time of Application on Performance of Selected Long-Grain Rice Varieties in Rapides Parish.

Rice in all N treatments was showing slight N deficiency symptoms when the experiment was permanently flooded May 22, 1985 because no preplant N had been applied. Plant response to the N treatments applied 1 day preflood was dramatic 7 days after permanent flood. Rice in the zero N treatments was extremely yellow within 7 days after flooding although they had shown only slightly yellowing before the permanent flood. The rapid plant growth induced by flooding caused the severe N deficiency symptoms in the relatively short time period. Rice plants in the 30 lb N/A rate began showing slight to moderate N deficiency symptoms within 14 days after permanently flooding the experiment.

Table 3. Effect of N rate and time of application in first crop on first crop, second crop, and total grain yields of rice varieties in the water-seeded system. Errol Lounsberry Farm, Vermilion Parish, LA. 1985.

Total N	Time of N*				First crop grain yield at 12% moisture				Second crop grain yield at 12% moisture***				Total grain yield at 12% moisture				N** MEAN
	PP	PI	PD		MARS	GFMT	LMNT	NWBT	MARS	GFMT	LMNT	NWBT	MARS	GFMT	LMNT		
																N**	
-----lb/A-----																	
0	--	--	--		5170	5260	5550	5800	5440 ^a	2630	2450	3510	5800	7800	7710	9060	7590 ^a
30	30	--	--		6180	6610	6870	7100	6690 ^b	2730	3070	3730	7100	8920	9680	10600	9070 ^b
60	60	--	--		6880	7080	7830	7860	7410 ^c	3210	3240	3740	7860	10090	10320	11570	9960 ^c
90	90	--	--		6480	7890	7890	8130	7600 ^{cd}	3310	3520	3960	8130	9790	11400	11850	10290 ^c
90	60	30	--		7130	7680	8180	8050	7760 ^{cd}	3300	3530	3430	8050	10430	11200	11610	10320 ^c
90	60	--	30		7690	7370	8030	8580	7920 ^d	3160	3260	3860	8580	10850	10630	11880	10490 ^c
120	120	--	--		6520	7680	8070	8560	7710 ^{cd}	3330	3300	3680	8560	9840	10990	11750	10280 ^c
150	150	--	--		5940	7780	7820	8560	7530 ^{cd}	2960	3230	3520	8560	8900	11010	11340	9950 ^c
Variety mean**					6500 ^a	7170 ^b	7530 ^c	7830 ^d		3080 ^a	3200 ^a	3680 ^b	7830 ^a	9580 ^b	10370 ^c	11210 ^d	
C.V., %							3.89					12.2				4.23	

* 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.

*** Newbonnet excluded because slow regrowth and delayed maturity resulted in no second crop.

The N requirement for all varieties was much higher than expected in the Moreland clay at this location. Maximum grain yield of all varieties was only attained by the 150 lb N/A rate (Table 4). The high N requirement was not expected because of the relatively high organic matter content of this soil. Plant growth observations and grain yields (Table 4) indicated that N fertilizer was not efficiently used by the rice in this experiment. Failure to maintain a continuous flood after preflood N application may have resulted in relatively high denitrification and volatilization losses of N fertilizer. Periods of soil exposure occurred periodically within 1 month after the experiment was flooded. The absence of lodging and yield reduction of the tall Lebonnet by application of 150 lb N/A indicates that a rather large amount of the N fertilizer was lost. Split N application resulted in significantly lower grain yields of all varieties than a single preflood application of 90 lb N/A. The 60 lb N/A preflood application was not enough to prevent early N deficiency before panicle initiation, and consequently, the 30 lb N/A topdressings at panicle initiation and panicle differentiation were too late to prevent yield reduction. Split N applications are usually less efficient than a single preflood application of the total N in the drill-seeded system if the preflood (basal) N rate is not high enough to promote normal plant growth and development through panicle initiation. These results were consistent with those obtained at the RRS in the Crowley silt loam soil.

Grain yields of these varieties were relatively high although a high N rate was required for maximum yield. The highest yielding variety was Lemont followed by Newbonnet, Gulfmont, and Lebonnet. Lemont was 1 day earlier than Gulfmont and 6 days earlier than Newbonnet. Gulfmont was expected to be earlier than Lemont as it was in southwest Louisiana.

Effect of N Rate and Time of Application on Performance of Selected Long-Grain Rice Varieties in the Water-Seeded System in Morehouse Parish.

Nitrogen treatments did not appear to influence seedling vigor in the water-seeded experiments in Morehouse Parish. Labelle was the least vigorous variety in these experiments but all other varieties emerged normally through the flood water. The water depth in replications three and four of these experiments was too deep (6 to 8 inches) for optimum varietal performance.

The influence of N rate and time of application on grain yields of very early rice varieties is shown in Table 5. All very early varieties except Bond required 150 lb N/A for maximum yield, however, near maximum yields were observed at 120 lb N/A. Tebonnet was the highest yielding variety followed by Bond, L-202, and Labelle based on average yields over N treatments (Table 5). Split application did not increase grain yield above that of a single preplant 90 lb N/A rate.

The effect of N rate and time of application on performance of early long-grain varieties in the water-seeded system in Morehouse Parish is shown in Table 6. Lemont required 120 to 150 lb N/A for maximum yield while the semi-dwarf Leah and tall Lebonnet required only 90 to 120 lb N/A (Table 6). The three varieties performed well at moderate N rates but Lemont generally required 30 lb N/A more than Leah and Lebonnet for maximum grain yield. Leah and Lemont yields were significantly greater than Lebonnet yields when averaged over N rates. The highest yields at optimum N rates were 8,180, 7,490, and 6,780 for Lemont, Leah, and Lebonnet, respectively. The three varieties

Table 4. Effect of N rate and time of application on grain yield of selected long-grain rice varieties in drill-seeded system. Will Bollich Farm, Rapides Parish, LA. 1985.

Total N	Time of N*			Grain yield at 12% moisture				N**
	PF	PI	PD	LBNT	GFMT	NWBT	LMNT	MEAN
-----lb/A-----								
0	--	--	--	2740	3120	2940	3540	3080 ^a
30	30	--	--	3520	3550	4320	4430	3950 ^b
60	60	--	--	5040	5680	5630	6050	5600 ^c
90	90	--	--	5890	7090	6620	7200	6700 ^d
90	60	30	--	5330	5860	6150	6200	5890 ^c
90	60	--	30	5340	5550	6170	6370	5860 ^c
120	120	--	--	5840	7570	7860	8360	7410 ^e
150	150	--	--	6100	8110	8690	8910	7950 ^f
Variety mean**				4970 ^a	5810 ^b	6050 ^c	6380 ^d	

LSD (0.05) for: N = 400; variety = 210; within N among varieties = 580; and among varieties among N = 580 lb/A.

C.V., % = 7.09

* Time of N: PF = preflood; PI = panicle initiation; PD = panicle differentiation.

** Means across and down columns followed by the same letter are not significantly different (P<0.05).

Table 5. Effect of N rate and time of application on grain yields of very early rice varieties in water-seeded system. Larry Tubbs Farm, Morehouse Parish, LA. 1985.

Total N	Time of N*			Grain yield at 12% moisture				N**
	PP	PI	PD	LBLE	L202	BOND	TBNT	MEAN
-----lb/A-----								
0	--	--	--	2540	2990	4010	4580	3530 ^a
30	30	--	--	4420	4680	4800	5240	4780 ^b
60	60	--	--	4670	5390	5920	6200	5540 ^c
90	90	--	--	6030	6520	6910	7300	6690 ^{de}
90	60	30	--	5950	6280	7170	7600	6760 ^{de}
90	60	--	30	5600	6460	6410	7380	6460 ^d
120	120	--	--	6440	7030	6950	7280	6930 ^{de}
150	150	--	--	6910	7250	7010	7880	7260 ^{de}
Variety mean**				5320 ^a	5830 ^b	6150 ^b	6680 ^c	

LSD (0.05) for: N = 680; variety = 260; among varieties within N = 730; and among N among varieties = 850 lb/A.

C.V., % = 7.37

* 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).

Table 6. Effect of N rate and time of application on grain yield of early long-grain rice varieties in water-seeded system. Larry Tubbs Farm, Morehouse Parish, LA. 1985.

Total N	Time of N*			Grain yield at 12% moisture			N**
	PP	PI	PD	LBNT	LMNT	LEAH	MEAN
-----lb/A-----							
0	--	--	--	3720	4010	4660	4130
30	30	--	--	5220	4840	5610	5220
60	60	--	--	6090	6260	6660	6340
90	90	--	--	6600	7160	7300	7020
90	60	30	--	6310	6500	7150	6660
90	60	--	30	5940	6420	6750	6370
120	120	--	--	6780	7930	7490	7400
150	150	--	--	6410	8180	7200	7260
Variety mean**				5890 ^a	6410 ^b	6600 ^b	

LSD (0.05) for: N = 380; variety = 180; between varieties within N = 500; and between varieties for different N = 560 lb/A.

C.V., % = 5.58

* 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).

performed well in the water-seeded system used at the Morehouse Parish location.

The effect of N rate and time of application on performance of midseason varieties in the water-seeded system in Morehouse Parish is shown in Table 7. Newbonnet and Starbonnet required 120 and 60 lb N/A, respectively, for maximum grain yield. Grain yield of tall Starbonnet was severely reduced by excessive N because of lodging, however, the yield of Newbonnet was only slightly reduced because it had good lodging resistance. Newbonnet was much more productive than Starbonnet which was consistent with results at other locations.

SUMMARY AND CONCLUSIONS

Field experiments were conducted in Vermilion, Rapides, and Morehouse Parishes to monitor N response patterns of new rice varieties in environments different from those of Crowley and northeast Louisiana. Nitrogen requirement in the water-seeded Vermilion Parish experiment was generally less than that required in the Crowley silt loam soil at the RRS. All varieties yielded well at low to moderate N fertilizer rates in Vermilion Parish.

Excellent first and second crop yields were observed when optimum N fertilizer management was used in the first crop. Suboptimum N rates produced low first crop yields and relatively high second crop yields, however, maximum first crop and second crop yields (total yields) were observed at the optimum first crop N rate. Excessively high first crop N rates reduced the growth rate and grain yield of the second crop. The semidwarf varieties Lemont and Gulfmont and tall Mars produced excellent second crop yields. Newbonnet regrowth was not rapid enough and maturity was delayed too long for second crop production. The average total yields (first and second crops) were 11,210, 10,370, 9,580, and 7,830 lb/A for Lemont, Gulfmont, Mars, and Newbonnet, respectively, when averaged over all first crop N treatments.

All varieties in the Rapides Parish experiment unexpectedly required 150 lb N/A for maximum yield. The high N requirement based on growth and grain yield probably resulted from excessive N loss caused by periodic loss of the flood water during the first 30 days after flooding. It was very unusual for tall Lebonnet to require 150 lb N/A for optimum yield. All varieties produced high yields at moderate to high N rates. Split N application greatly reduced yield below a single preflood application of 90 lb N/A.

All varieties in the Morehouse Parish experiments except Tebonnet required moderate N rates for high yields. Tebonnet required 150 lb N/A. Yield potentials of all varieties were limited because of deep water in the third and fourth replications of the Morehouse Parish experiments.

These off-station experiments show that N response of rice varieties vary by location because of environmental differences. Consequently, extrapolation of on-station results and results from other locations to different locations may be invalid. Studies should be continued to monitor the performance of new rice varieties in different environments and management systems.

Table 7. Effect of N rate and time of application on grain yield of midseason rice varieties in water-seeded system. Larry Tubbs Farms, Morehouse Parish, LA. 1985.

Total N	Time of N*			Grain yield at 12% moisture		
	PP	PI	PD	STBT	NWBT	N** MEAN
-----lb/A-----						
0	--	--	--	4750	4960	4850 ^a
30	30	--	--	5240	5320	5280 ^b
60	60	--	--	5810	6870	6340 ^{cd}
90	90	--	--	5580	6860	6220 ^{cd}
90	60	30	--	5470	6380	5920 ^c
90	60	--	30	5380	6540	5960 ^c
120	120	--	--	5700	7340	6520 ^d
150	150	--	--	4890	7010	5950 ^c
Variety mean**				5350 ^a	6410 ^b	

LSD (0.05) for: N = 320; variety = 150; between varieties within N = 420; and between varieties among N = 430 lb/A.

C.V., % = 4.84

* 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).

COMPARATIVE EFFECT OF UREA AND DICYANDIAMIDE APPLIED AT DIFFERENT
TIMES ON YIELD OF LEMONT RICE IN THE DRY-SEEDED SYSTEM

(A Preliminary Report)

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

INTRODUCTION

Fertilizer nitrogen (N) is required for profitable rice production on virtually all of the Louisiana rice acreage. Use of management practices that favor maximum plant use efficiency of N are necessary to reduce costs and increase rice profitability. Fertilizer N efficiency is influenced by N source, rate, placement, time of application, rice variety, water management, and other factors.

Nitrogen loss by denitrification and volatilization may greatly decrease N efficiency and grain yields in dry-seeded, water-seeded-drained, and water-seeded-continuous flood cultural systems. The amount of N loss by denitrification and volatilization processes depends primarily on the time and method of N fertilization in relation to water management. Dry-seeded rice is usually flushed with irrigation water and/or rain fed until rice seedlings are in the 4th to 5th leaf stage, at which time the crop is permanently flooded for the duration of the growing season. Water-seeded rice is often drained immediately after seeding and flushed with irrigation water and/or rain fed until seedlings are in the 4th to 5th leaf stage, at which time the crop is permanently flooded. Rice in the water-seeded-continuous flood system is usually flooded, drained temporarily, and reflooded for the duration of the season. The soil is not allowed to dry in the water-seeded-continuous flood system.

Rice usually shows N deficiency symptoms within 15 to 25 days after seeding in all systems unless some N fertilizer is applied preplant or soon after seeding. Ammonium N applied preplant or soon after seeding in the dry-seeded systems is subject to denitrification and ammonia volatilization. Consequently, preplant and postflood application of large amounts of N is inefficient in these systems.

Nitrification inhibitors and proper timing of N in relation to the permanent flood may reduce N loss and improve efficiency in the dry-seeded and water-seeded-drained cultural systems. An effective nitrification inhibitor that prevents or delays nitrification of NH_4 could be soil incorporated with N preplant and assure retention of the N in the soil for plant utilization during the season. Nitrogen timing studies have shown that application of N as urea on the dry soil surface just before permanently flooding dry-seeded rice is more efficient than N applied preplant or postflood. These studies also showed that some N preplant is required to prevent seedling N deficiency which slows growth and delays the permanent flood. Numerous studies have shown that N fertilizer should be soil incorporated preplant before flooding in the water-seeded-continuous flood system for maximum N efficiency. Early N application

is necessary for maximum rice yield but the early N is subject to denitrification loss in the dry-seeded cultural systems because of alternate wetting and drying of the soil. An effective nitrification inhibitor should conserve N and greatly improve N fertilizer efficiency in the dry-seeded and water-seeded-drained systems.

The objectives of the 1985 studies were to: 1) Determine the relative efficiency of Dicyandiamide (DCD) in relation to urea and 2) Determine the influence of time of application on relative efficiency of the two N sources. Preflood application of urea on a dry soil surface just before permanently flooding the rice was considered the standard commercial practice in the dry-seeded system.

MATERIALS AND METHODS

Two field experiments were conducted in southwest and northeast Louisiana to study the comparative efficiency of urea and DCD when applied at different times in dry-seeded rice. One experiment was conducted in southwest Louisiana to determine the relative efficiency of urea, DCD, and sulfur coated urea (SCU) in water-seeded rice. The cultural practices used and other agronomic factors are given in Table 1.

The soil fertility properties of the three experimental sites in the 0- to 4-inch soil depth are typical of the Crowley silt loam and Sharkey clay soils used for rice production in Louisiana (Table 2). The characteristically low extractable P and K levels in the Crowley silt loam soil indicated a need for P and K fertilizer for maximum grain yield. The Sharkey clay required no P and K fertilizer because of the relatively high levels of these plant nutrients in this soil.

The N sources and time of application studied in the three experiments are shown in Table 3. All of the N as urea was either applied preplant and/or preflood in the three dry-seeded (1 and 2) and the water-seeded experiments (3). Urea was also split in the dry-seeded experiments to provide 50% of the total N preflood, plus 25% of the total N at the panicle differentiation (PD) growth stage, plus 25% of the total N at PD plus 14 days. This 50-25-25% N split is commonly recommended in Arkansas. A 2-way split N application consisted of 67% of the total N preflood plus 33% of the total N at the panicle initiation (PI) growth stage in the two dry-seeded experiments. All of the N as DCD was applied preplant and/or preflood in all three experiments. The DCD used in Experiments 1 and 2 was provided by SKW Trostberg in 1985, however, that used in Experiment 3 was provided by SKW Trostberg in 1984. Sulfur coated urea with a dissolution rate of 25% (SCU-25) was used only in the water-seeded experiment (3) and was applied preplant. All preplant N treatments were applied with a precision applicator and lightly soil incorporated. Preflood N treatments were hand-broadcast on a dry soil surface within 24 hours before permanently flooding the rice. Topdress N applications were hand-broadcast into the flooded rice at the indicated times.

Nitrogen rates of 0, 30, 60, 90, 120, and 150 lb/A were used in all experiments. Phosphorous and K were band-placed preplant at 60 lb/A P_2O_5 and K_2O in Experiments 1 and 3. The experimental design was split plot in a randomized complete block with four replications. Nitrogen rates were assigned to main plots and N source and time were assigned to subplots. Individual plot dimensions were 7 x 25 ft (175 ft²).

Table 1. Agronomic factors and cultural practices. Rice Research Station, Crowley, LA. 1985.

Agronomic factor and cultural practice	Experiment No. 1	Experiment No. 2	Experiment No. 3
Location	Rice Res. Stn.	E. Carroll	Rice Res. Stn.
Soil type	Crowley silt loam	Sharkey clay	Crowley silt loam
Fertilization			
P ₂ O ₅ & K ₂ O (lb/A)	60	0	60
Method	Banded	Banded	Banded
Seeding rate (lb/A)	100	100	150
Seeding date	5/2/85	5/7/85	4/12/85
Irrigation: flushed	3X	6X	NA
Permanent flood	5/27/85	6/13/85	4/11/85
Emergence	5/8/85	5/25/85	4/24/85
Pest control	Commercial	Commercial	Commercial
Harvest date	7/25/85	10/27/85	7/9/85

Table 2. Soil fertility status of experimental sites. Rice Research Station, Crowley, LA. 1985.*

Soil type	pH	Organic matter ---%---	Extractable nutrients					
			P	K	CA	Mg	Na	Zn
			-----ppm-----					
Crowley silt loam	6.3	0.75	10	58	1543	293	110	1.41
Sharkey clay	6.1	1.63	87	500	4000	1000	97	5.98

* Analytical methods in: Brupbacker, R.H., W.P. Bonner, and J.E. Sedberry, Jr., 1980. Analytical methods and procedures in the soil testing laboratory. Louisiana Agri. Exp. Stn., LSU Agric. Center Bull. 632.

Table 3. Nitrogen sources and time of application by experiment. Rice Research Station, Crowley, LA. 1985.

Nitrogen source and time of application	Experiment number		
	Dry-seeded 1	Dry-seeded 2	Water-seeded 3
Urea: 100% preplant	X	X	X
Urea: 100% preflood	X	X	X
Urea: 50% preflood + 25% @ PD + 25% @ PD + 15 days	X	X	-
Urea: 67% preflood + 33% @ PI	X	X	-
DCD: 100% preplant	X	X	X
DCD: 100% preflood	X	X	-
SCU: 100% preplant	-	-	X

Rice was drill-seeded at 100 lb/A May 2 and 7, 1985 in Experiments 1 and 2, respectively. Presoaked seed was water-seeded at 150 lb/A April 12, 1985 in Experiment 3. The rice variety 'Lemont' was used in all three experiments. Experiment 1 was flushed with irrigation water three times to enhance seedling emergence and stand establishment and a permanent flood of 2 to 4 inches was established 19 days after seedling emergence. Experiment 2 was flushed with irrigation water six times to enhance seedling emergence and prevent moisture stress until permanently flooded 19 days after seedling emergence. Experiment 3 was flooded for 4 days after seeding, drained for 5 days to enhance seedling anchorage, and reflooded to a depth of 2 to 4 inches for the duration of the growing season.

Leaf samples consisting of 50 most recently matured leaves (y-leaf) were randomly collected from each plot at panicle initiation to determine the plant N status in each plot. Leaf samples were oven dried at 70°C for 48 hrs and then ground in a Wylie mill to pass a 20 mesh screen. Total N in the samples is currently being determined by the Kjeldahl method.

Variables measured included total N, number of days to 50% heading, plant height, lodging, grain yield, and grain moisture. Whole plots (175 ft²) were combine-harvested and grain yields adjusted to 12% moisture. The grain yield variable only will be reported because statistical analysis of the other variables has not been completed by Experimental Statistics, Louisiana State University, Baton Rouge, LA.

RESULTS AND DISCUSSION

Results of the three experiments are discussed individually because of location effects and treatment differences. The summary will provide an overall integration of results to identify significant conclusions and areas that require additional studies.

Experiment 1. Effect of Urea and DCD Applied at Different Times on the Performance of Drill-Seeded Lemont Rice in the Crowley Silt Loam Soil.

Rice in all treatments that received no preplant N showed N deficiency symptoms 15 days after seedling emergence from the soil. Plants in the preplant N treatments were greener in color and grew more rapidly than plants in the treatments that received no preplant N. Moreover, rice in the preplant N treatments recovered more rapidly from the foliar burn caused by propanil-thiobencarb herbicide application just before permanent flood. Rice in the DCD preplant treatments appeared to recover from the herbicide burn more rapidly than did rice in the urea preplant treatments. These observations indicate that N deficiency in the early seedling stage limits growth in the Crowley silt loam soil unless some N is applied to maintain growth until the basal N is applied just before the permanent flood [usually 20 to 30 days after planting (DAP)]. Observation of plant growth and color 70 DAP indicated the following relative efficiency of treatments in decreasing order: DCD prelood = urea prelood > DCD preplant > 67% urea prelood + 33% urea @ PI > urea preplant > 50% urea prelood + 25% urea @ PD + 25% urea @ PD plus 14 days.

The relative influence of urea and DCD on yield when applied at different times in relation to permanently flooding drill-seeded Lemont rice is shown in Table 4. There was a significant N source and time by N rate interaction with grain yield differences among treatments greater at lower N rates and differences less at higher N rates. Grain yield of all treatments except the 3-way N split was similar at the 150 lb/A N rate, however, the 3-way N split produced significantly lower yield than the other treatments. At intermediate N rates (90 to 120 lb/A), DCD prelood, DCD preplant, urea prelood, and urea 2-way split were apparently more efficient based on yield than were the urea preplant and urea 3-way split. Urea prelood and DCD prelood were the most efficient treatments at low N rates (30 to 60 lb/A). The results generally indicate that DCD N applied prelood or preplant was used as efficiently as urea N prelood. Application of 100% of the N as urea preplant and application of urea N in the 3-way split resulted in less efficient N utilization by dry-seeded Lemont rice in the Crowley silt loam soil. These results indicate that DCD effectively conserved N in the dry-seeded system when applied preplant or prelood, however, urea applied on the dry soil surface prelood conserved N for plant use equally as well as DCD.

Experiment 2. Effect of Urea and DCD Applied at Different Times on the Performance of Drill-Seeded Lemont Rice in the Sharkey Clay Soil.

Rice in all treatments that received no N preplant showed only very slight N deficiency symptoms before permanently flooding the experiment. The urea and DCD preplant did result in slightly more growth and a greener plant color early, but the intensity of N deficiency symptoms and N response were much less than those observed in the Crowley silt loam soil (Experiment 1). The zero N treatments showed moderate deficiency symptoms within 2 weeks after permanently

Table 4. The effect of N sources and time of application on grain yield of Lemont rice in the drill-seeded system. Rice Research Station, Crowley, LA. 1985.

Source and time of application*	Grain yield @ 12% moisture, lb/A						Source and time mean
	Total N rate, lb/A						
	0	30	60	90	120	150	
Urea: 50% PF, 25% PD, 25% PD + 15 days	3170	4320	4930	5450	6680	6580	5190
Urea: 100% PP	3170	4140	5230	5630	6610	7020	5300
Urea: 67% PF + 33% PI	3150	4300	5580	5850	7020	7090	5500
DCD: 100% PP	3150	4010	5650	6400	7180	7260	5610
Urea: 100% PF	3170	4640	5870	6440	6880	7091	5680
DCD: 100% PF	3150	4350	5540	6090	6930	6980	
N rate mean	3160	4350	5540	6090	6930	6980	

LSD (.05) for: N rate = 350; N source & time = 130; N source and time within N rate = 300; and N source & time over N rate = 450 lb/A

C.V. = 4.06%

* PF = Preflood; PP = Preplant; PI = Panicle initiation; PD = Panicle differentiation.

flooding the rice, however, the 60 to 150 lb N/A rates showed no N deficiency symptoms throughout the season. Rice in the urea 100% preplant and DCD preplant treatments 20 days after permanent flood was taller than that in the preflood treatments, but rice in the preflood treatments was darker green in color.

The relative influence of urea and DCD applied at different times in relation to permanent flood on grain yield of drill-seeded Lemont rice in the Sharkey clay soil is shown in Table 5. The N fertilizer requirement was low in this soil because of a relatively high level of native N. Although significant yield differences among treatments were observed, the differences were relatively small. The amount of N required for optimum yield appeared to be 30 to 90 lb N/A, depending on N source and time of application. The 3-way N split performed equally to DCD preplant and urea preplant which produced higher grain yields than did urea and DCD preflood. Urea and DCD preflood produced significantly higher yields than other treatments at the 30 lb N/A rate but the advantage of these treatments diminished at higher N rates. These results

Table 5. The effect of N source and time of application on grain yield of Lemont rice in the drill-seeded system. Buford Perry Farm, East Carroll Parish. 1985.

Source and time of application*	Grain yield @ 12% moisture, lb/A						Source and time mean
	Total N rate, lb/A						
	0	30	60	90	120	150	
Urea: 100% PF	8450	9200	8960	9220	8720	8670	8870
Urea: 67% PF + 33% PI	7960	8790	9150	9500	9380	9010	8960
DCD: 100% PF	7960	9270	9450	9450	9110	8590	8970
Urea: 100% PP	8450	8690	8910	9620	9520	9130	9050
Urea: 50% PP + 25% PD + 25% PD + 14 days	8450	8700	9460	9330	9340	9490	9130
DCD: 100% PP	7960	8720	9510	9580	9630	9820	9200
N rate mean	8210	8900	9240	9450	9280	9120	

LSD (.05) for: N rate = 290; N source and time = 140; N source and time within N rate = 340; N source and time over N rate = 300 lb/A

C.V. = 2.70%

* PF = Preflood; PP = Preplant; PI = Panicle initiation; PD = Panicle differentiation.

generally indicated that in this N fertile Sharkey clay soil use of either urea or DCD in any time combination resulted in high yields at relatively low total N rates. Greater differences among N sources and time of application would be expected if the native N had been lower in this Sharkey clay soil.

Experiment 3. Effect of N source on the Performance of Water-Seeded Lemont Rice in the Crowley Silt Loam Soil.

Rice in the zero N treatments began showing N deficiency symptoms 20 DAP. Rice in the low N rates of DCD was more N deficient than that in the urea and SCU at the same N rate 46 DAP. The higher N rates of all sources showed no N deficiency symptoms.

The influence of N source on grain yield of Lemont rice in the water-seeded system is shown in Table 6. The relative efficiency of the sources based on yield was of the order: SCU > urea = DCD. Yields of rice in the SCU

Table 6. Effect of N source on the performance of Lemont rice in the water-seeded-continuous flood cultural system. Rice Research Station, Crowley, LA. 1985.

N rates lb/A	Grain yield @ 12% moisture, lb/A			N rate mean
	N source*			
	Urea	DCD	SCU	
0	2210	2210	2210	2210
30	3760	3820	4050	3880
60	5440	5820	6130	5800
90	6900	6660	7850	7140
120	7960	8230	8790	8330
150	8620	8570	9000	8730
Source mean	5820	5880	6340	

LSD (.05) for: N rate = 400; N source = 130; N source within N rate = 330;
N source between N rates = 480 lb/A

C.V. = 3.77%

* N source: DCD = Dicyandiamide; SCU = Sulfur coated urea.

treatment at all N rates were greater than those in the urea and DCD treatments probably because of less N loss from the soil. The DCD did not increase N efficiency over urea, however, the DCD material used was from a DCD lot prepared in 1984. Since the 1984 DCD material was prepared by spraying DCD on the surface of urea, the material may have been less effective than the 1985 DCD lot which had DCD incorporated in the urea granule. The 1985 DCD was used in Experiments 1 and 2 but it did not arrive soon enough to be used in Experiment 3.

SUMMARY AND CONCLUSIONS

Three field experiments were conducted to study the influence of N sources and time of application on the performance of dry- and water-seeded Lemont rice. DCD applied preplant and/or pre flood and urea applied pre flood were more efficient than urea applied preplant or urea applied in a 3-way split in the dry-seeded system in the Crowley silt loam soil. More N as urea preplant was required to give equivalent yield to that of urea pre flood and DCD preplant or pre flood. The 3-way N split (50% urea pre flood + 25% @ PD + 25% @ PD plus 14 days) was not effective in the Crowley silt loam probably because the amount of pre flood urea (50%) was not great enough to prevent early N deficiency which

limited plant tillering. This 3-way N split was effective, however, in the more fertile Sharkey clay soil that required much less total N for optimum grain yields. These data indicate that DCD preplant or pre flood in the dry-seeded system effectively retained N in the soil-plant system for rice utilization. The DCD may have been more efficient than urea in the dry-seeded system because it may minimize N loss through denitrification when applied preplant and through both denitrification and volatilization when applied pre flood. Additional studies should be conducted to measure fertilizer N retention in the soil and influence on plant growth and yield when applied as DCD preplant and pre flood.

Sulfur coated urea was more efficiently used by water-seeded rice than was urea and DCD. Although relative efficiency of DCD and urea was good in this system, N as SCU unexpectedly produced significantly higher yields at all N rates. The average yields of Lemont were much greater in the water-seeded experiment than in the drill-seeded experiment at Crowley. Higher yields were expected in the water-seeded Lemont because previous studies have shown similar results.

RICE FOUNDATION SEED PROGRAM

Lawrence W. 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 87,000 cwt. of pedigreed stock of 19 rice varieties.

Concurrent with the distribution of pure seed by the 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 Research Station's seed program, Louisiana farmers may obtain seed rice of improved varieties developed through the cooperative LSU-USDA 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 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 Station's seed stocks. The nursery also serves as a site for evaluating, purifying, and increasing selections from the cooperative breeding program which show promise as new varieties.

The distribution of pedigreed seed rice produced by the Rice 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 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 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 prelood 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 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 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.

1985 Activities

Of the 2342 cwt. of foundation seed rice sold in March 1985, the varieties and quantities were as follows: Lemont, 1400 cwt.; Labelle, 424 cwt.; Mars, 480 cwt.; and Saturn, 38 cwt. An additional 662 cwt. of Mars, 461 cwt. of Labelle, and 213 cwt. of Saturn were downgraded to registered class and sold on bids.

The Rice Research Station's foundation seed rice crop in 1985 consisted of 9.85 acres of Tebonnet, 14.87 acres of Newbonnet, 16.20 acres of Mars, and 37.48 acres of Lemont.

Breeder seed was grown in 1985 as follows: Lemont, 1.2 acres; Tebonnet, 1.0 acre; and Newbonnet, 1.0 acre.

RICE FIELD PEST MANAGEMENT

BORDERLAND RED FOR PROTECTING SPROUTING RICE FROM BLACKBIRD DAMAGE^{1/}

(A Progress Report)

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INTRODUCTION

Blackbirds (Icteridae) are responsible for locally serious sprouting rice damage, and monetary loss to an individual farmer can be substantial. The problem in Louisiana during 1982 and 1983 was judged severe enough for the granting of emergency-use permits (Section 18 of the Federal Insecticide, Fungicide and Rodenticide Act) for Mesurol 75% Seed Treater (Mobay Chemical Corp.), a methiocarb-based bird repellent. Although Mesurol has provided excellent protection to sprouting rice when used at seed treatment rates of 2 and 4 oz ai/cwt (Holler et al., 1985), the high cost of using Mesurol-treated seed (\$10 to \$12/A) has limited economical use of the product. Additionally, analysis of Mesurol-treated seed for methiocarb residue has indicated problems with the retention of methiocarb on seed. Mesurol must be applied to seed at rates higher than are necessary for bird repellency, because much of the methiocarb seed treatment is lost between the initial treatment of seed and the exposure of seed to birds following drainage of paddy water.

In 1983, Mobay Chemical Cooperation granted nonexclusive rights for the manufacture of a methiocarb seed treatment for rice to Borderland Products, Inc. Subsequently, Borderland announced the development of a new methiocarb-based bird repellent, Borderland Red. This product reportedly contained binding agents that improved the retention of methiocarb on rice seed, thus allowing the use of a lower seed treatment rate, and resulting in lower expense (\$7/A) to the grower. In 1984, the U.S. Environmental Protection Agency granted a Section 18 emergency-use registration to Louisiana for the use of Borderland Red at 0.64 oz ai/cwt to protect sprouting rice from bird damage. However, in test fields planted with Borderland Red-treated seed (0.64 oz ai/cwt), almost total sprout loss was observed (Holler et al., 1985). Analysis of Borderland Red-treated seed indicated that methiocarb concentrations on seed following field drainage were insufficient to protect rice from bird damage.

Borderland Red was reformulated following the failure of the original product to reduce bird damage in 1984. In 1985, Borderland Products, Inc. obtained an emergency-use permit for the new Borderland Red formulation to be marketed in Louisiana at a rate of 1.71 oz ai/cwt.

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This study was conducted to evaluate Borderland Red (1985 formulation) at two seed treatment rates (1.0 and 1.71 oz ai/cwt) for potential use as a bird repellent on water-seeded sprouting rice.

MATERIALS AND METHODS

This test was conducted in Vermilion Parish, Louisiana, during March and April 1985^{3/}. Arrangements were made with growers to use nine 7- to 14-acre fields in close proximity to the coastal marsh, where blackbird roosting populations are traditionally high.

Rice seed was treated with Borderland Red at rates of 1.0 and 1.71 oz ai/cwt by tumbling for 15 min in a concrete mixer. Seed was treated in 100-lb batches, returned to bags, and allowed to dry for at least 24 hr prior to use.

Three of the nine fields were randomly selected to receive seed treated with Borderland Red at the 1.0 oz rate and three fields were randomly selected to receive seed treated at the 1.71 oz rate. The remaining three fields served as untreated checks. Each field was aerially planted with 135 to 155 lb of pregerminated seed per acre. Rice was grown using normal cultural practices, as determined by the cooperating grower.

To determine sprout loss, 50 paired sample points, each consisting of two 2-ft² plots, were located 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 three strata of equal width. Four transects were randomly located within and parallel to the long axis of 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 ft away on a randomly selected bearing from the transect. Enclosures, 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 in 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 treated and untreated fields.

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

Three 6 x 100 ft transects were established in cover adjacent to each test field, in localities where birds might be expected to rest following feeding. To determine if the consumption of methiocarb-treated seed caused avian mortality, these transects were searched for dead birds at least twice each week during the period between field drainage and damage assessment. Fields and field perimeters were searched for dead birds at least once each week between field drainage and damage assessment.

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Seed and seedling samples were collected to determine the effectiveness of the Borderland Red formulation in retaining methiocarb on seed (or seedlings) during and after water planting. Since bird repellent efficacy is dependent upon post-draining concentrations of methiocarb on seed and seedlings, these samples were necessary to evaluate the efficacy of Borderland Red when used on water-seeded sprouting rice. Soil and water samples were collected at the request of Borderland Products, Inc. The following samples were collected, frozen, and shipped to Craven Laboratories, Inc. (Austin, Texas) to be analyzed for methiocarb residues:

1. Two 30 oz seed samples (each consisting of ten 3 oz samples pooled) from each of six treated seed batches, one taken immediately after treatment, the other taken following presoaking for 24 to 36 hr.
2. 500 seeds (five 100-seed samples from randomly selected points pooled) from each of six treated fields immediately after draining.
3. 500 seedlings (five 100-seedling samples from randomly selected points pooled) from each of six treated fields 1 week after draining, and 2 weeks after draining.
4. At least six 1 qt water samples taken from randomly selected points in each of three fields treated with 1.71 oz ai/cwt of Borderland Red, at least three taken before planting, and three taken within 4 hr following planting.
5. One 1 qt water sample taken before planting from the intake canal of each of the three fields receiving the 1.71 oz treatment.
6. At least two 1 qt water samples from the field outlet of each of the three 1.71 oz-treated fields, one taken soon after the initiation of draining, and at least one taken late in the draining period.
7. Two 1 qt water samples from the drainage canal of each of two fields receiving the 1.71 oz treatment, one taken soon after the initiation of draining, and one taken late in the draining period.
8. Six 1 qt water samples from each of three locations (drainage canal, primary receiving water-0.5 miles from field outlet, and secondary receiving water-2.1 miles from field outlet) associated with one of the 1.71-treated fields, one taken during field draining, the others taken on 5 consecutive days following field drainage.
9. Three 15.5 in³ soil samples (each consisting of five 0.8 in diam x 6 in deep soil samples from randomly selected points pooled) from each of three fields treated with 1.71 oz ai/cwt of Borderland Red, one taken before planting, one taken at planting (within 4 hr after planting), and the other taken at damage assessment (15 to 16 days after planting).

RESULTS AND DISCUSSION

Methiocarb residues on seed immediately after treatment averaged 691 ppm for the 1 oz treatments and 959 ppm for the 1.71 oz treatments. These were 110.6 and 89.7%, respectively, of the theoretical treatment rates (Table 1). Methiocarb loss during the 24 to 36 hr presoaking period averaged 38.6 and

Table 1. Methiocarb residue on seed and seedling samples collected during the testing of Borderland Red, Vermilion Parish, LA. 1985.

Treatment	Field	Methiocarb residue (ppm)					
		Seed post- treatment (theoretical)	Seed post- treatment	Seed post- soak	Seed post- drain	Seedling 1 week	Seedling 2 weeks
Borderland Red	1	625	735	411	101	10	14
(1.0 oz ai/cwt)	2	625	678	416	127	12	3
	3	625	660	445	32	8	7
	Average		691	424	87	10	8
Borderland Red	4	1069	1105	788	35	26	15
(1.71 oz ai/cwt)	5	1069	830	818	38	9	11
	6	1069	943	823	40	13	12
	Average		959	810	38	16	13

15.5% of the initial treatments for the 1.0 and 1.71 oz seed treatments, respectively. Methiocarb loss between field planting and drainage averaged 48.8% for the 1.0 oz seed treatments and 80.5% for the 1.71 oz treatments. Methiocarb residues on seed, when first exposed to bird attacks, averaged 12.6 and 4.0%, respectively, of the initial 1.0 and 1.71 oz seed treatments. One week after field draining, methiocarb residues averaged 1.4 and 1.7%, respectively, of the initial 1.0 and 1.71 oz seed treatments.

The extremely low post-draining methiocarb levels observed in this study (Table 1) can best be attributed to problems with the Borderland formulation, rather than insufficient post-treatment concentrations of methiocarb. In a 1983 test of Mesuro 75% ST (2 oz ai/cwt), another methiocarb-based formulation, post-draining methiocarb concentrations on seed averaged 720 ppm after seed remained in water an average of 10 days (Holler et al., 1985). In comparison, post-draining concentrations of methiocarb on seed treated with Borderland Red (1.71 oz ai/cwt) averaged 38 ppm following a 2- to 3-day exposure to water. The large variation in post-draining methiocarb levels between the Mesuro 75% ST and Borderland Red cannot be accounted for by the small difference in treatment rates (181 ppm). Adequate bird repellency requires that a minimum of 100 ppm of methiocarb be retained on seed throughout the bird-vulnerable period (2 to 3 wk) (Don Cunningham, Denver Wildlife Research Center, personal communication). Thus, it appears that the retention of methiocarb on seed using Borderland Red in a water-planted system was inadequate.

Sprout loss in fields treated with 1.0 and 1.71 oz ai/cwt of Borderland Red averaged 62.8 and 33.5%, respectively, compared to 98.6% for untreated fields (Table 2). Absolute sprout loss in fields treated at the 1.71 oz rate was significantly less ($P < 0.05$) than that in untreated fields. However, in two of the three fields treated at the 1.71 oz rate (fields 5 and 6), damage was severe enough that replanting would be necessary. A sprout density of at least 8 plants/ft² is required to produce adequate rice stands (Steve Linscombe, LSU

Table 2. The effects of Borderland Red seed treatments on sprout loss in test fields, Vermilion Parish, LA. 1985.

Treatment	Field	Expected no. of sprouts	Estimated sprout loss ^{1/}	
			% $\pm$ SE	Total $\pm$ SE
Borderland Red (1.0 oz ai/cwt)	1	6,940,644	59.3 $\pm$ 4.7	4,113,173 $\pm$ 325,504
	2	6,811,928	82.2 $\pm$ 7.0	5,602,066 $\pm$ 476,551
	3	10,361,070	46.8 $\pm$ 11.1	4,851,531 $\pm$ 1,145,372
	Average		62.8	4,855,590
Borderland Red (1.71 oz ai/cwt)	4	11,981,490	1.5 $\pm$ 6.4	181,209 $\pm$ 768,869
	5	6,115,580	33.3 $\pm$ 5.8	2,038,329 $\pm$ 352,812
	6	6,640,469	65.8 $\pm$ 7.1	4,366,997 $\pm$ 474,414
	Average		33.5	2,195,512*
Check	7	6,798,018	98.9 $\pm$ 7.5	6,726,617 $\pm$ 507,414
	8	9,139,667	98.9 $\pm$ 10.3	9,041,825 $\pm$ 940,968
	9	6,077,175	98.1 $\pm$ 6.4	5,961,935 $\pm$ 389,430
	Average		98.6	7,243,459

^{1/} Means followed by asterisks were significantly different from the mean for the untreated checks (P<0.05).

Cooperative Extension Service, personal communication). Although normal seeding rates (120 to 160 lb/A) commonly result in sprout densities in excess of those needed for adequate rice stands, the distribution of bird damage in a rice field is typically irregular, and results in inadequate rice stands in some parts of the field. In approximately 36% of field 5 and 66% of field 6, sprout density was below the minimum necessary to produce adequate stands of rice.

Of all treated fields, only field 4 failed to receive serious bird damage (Table 2). There is some evidence that the low sprout loss in field 4 was not due to chemical activity alone, since methiocarb residues on seed were similar to those in other fields which received heavy damage (Table 1). Of the nine test fields, only field 4 was located in close proximity to other planted fields, a factor which may account for reduced bird pressure. Additionally, rice in field 4 sprouted more quickly than in other fields, thereby reducing the period of vulnerability to bird damage.

During 61 30-min censuses, blackbird counts (birds per minute of observation) in fields treated with 1.0 and 1.71 oz ai/cwt of Borderland Red averaged 120 and 83, respectively, compared to 1021 for untreated checks (Table 3). Bird use (birds per minute) of untreated fields was extremely high; this resulted in almost total loss of sprouting rice within 3 to 4 days following field drainage. Damage to treated fields was the result of significantly less ($P < 0.05$) bird use extending over a longer period of time (1 to 2 wk). In a 1983 study, bird use averaging 52 birds per minute over a 10 day period resulted in almost total loss of sprouting rice in fields similar in size to

Table 3. Blackbird counts (birds/min) in test fields, Vermilion Parish, LA. 1985.

Treatment	Field	No observation periods	Birds per minute (overall mean)	Range (daily means)
Borderland Red (1.0 oz ai/cwt)	1	9	80	5 - 375
	2	7	124	52 - 346
	3	9	157	8 - 765
	Average	8.3	120	
Borderland Red (1.71 oz ai/cwt)	4	6	36	5 - 81
	5	7	87	7 - 260
	6	7	127	9 - 243
	Average	6.7	83	
Check	7	3	2011	1783 - 2183
	8	6	375	225 - 552
	9	7	676	103 - 1250
	Average	5.3	1021	

those in this study (Holler et al., 1985). In the present study Red-winged Blackbirds (Agelaius phoeniceus) were responsible for most rice damage; redwings made up 97.9% of target birds observed. Boat-tailed Grackles

(Cassidix mexicanus) accounted for 1.9% of blackbirds observed in test fields. Brown-headed Cowbirds (Molothrus ater) and Common Grackles (Quiscalus quiscula) each made up 0.1% of target birds observed.

No dead birds were observed on test fields, along field perimeters, or in adjacent cover. Shorebirds were the only nontarget species commonly observed in test fields. Mourning doves (Zenaida macroura), the only granivorous nontarget birds observed in test fields, were seen infrequently. Ducks commonly feed in newly-planted flooded rice fields, but were not observed during this study, probably because fields were drained soon after planting.

Methiocarb residues were detected in water collected from fields, field outlets, and drainage canals at sites receiving the Borderland Red 1.71 oz treatments (Table 4). Methiocarb concentrations ranged from 0.006 to 0.176 ppm in field water, 0.039 to 0.079 ppm in water taken at field outlets, and <0.005 to 0.026 ppm in drainage canal water. These concentrations may be high enough to cause mortality of some aquatic organisms. Median lethal concentrations (LC50-96 hr) of methiocarb are: 0.014 ppm for caddisfly larvae (Hydropsyche sp.), 0.007 ppm for mayfly nymph (Isonychia sp.), 0.10 ppm for river horn snail (Oxytrema catenaria), 0.11 ppm for juvenile glass shrimp (Palaemonetes kadiakensis) (Marking and Chandler, 1981), 0.051 ppm for Atlantic silverside (Menidia menidia), and 0.065 ppm for grass shrimp (Palaemonetes pugio) (Brunson et al., 1985).

Methiocarb residues were detected in soil samples collected from two of the three fields treated with 1.71 oz ai/cwt of Borderland Red (Table 5). Methiocarb concentrations ranged from 0.02 ppm 3 hours after planting to 0.06 ppm 15 days after planting (at damage assessment). The degradation period for methiocarb in paddy soils was not determined. The half life of methiocarb ranges from 4 days in alkaline soils to 56 days in acidic soils (Guarino, 1975). Most soils in the rice-growing area of southwestern Louisiana are acidic (Lytle and Sturgis, 1962). Environmental hazards associated with methiocarb in soils are not well documented.

SUMMARY AND CONCLUSIONS

Borderland Red, a methiocarb-based bird repellent, was evaluated as a water-seeded sprouting rice protectant at high bird pressure sites in Vermilion Parish, Louisiana, during March and April 1985. Sprout loss in fields treated with 1.0 and 1.71 oz ai/cwt of Borderland Red averaged 62.8 and 33.5%, respectively, compared to 98.6% for untreated fields. Blackbird counts (birds per minute) averaged 120 and 83 in fields treated at the 1.0 and 1.71 oz rates, respectively, compared to 1021 for untreated checks. Absolute sprout loss in fields treated at the 1.71 oz rate was significantly less ($P < 0.05$) than that in untreated fields. Retention of methiocarb on treated seed was poor. In fields treated with 1.0 and 1.71 oz ai/cwt of Borderland Red, 87.4 and 96.0%, respectively, of the methiocarb was lost between the initial seed treatments and the exposure of seed to bird depredations by drainage of paddy water. At sites receiving the 1.71 oz treatment, methiocarb residues ranged from <0.005 ppm to 0.176 ppm in paddy and canal waters, and from <0.02 ppm to 0.06 ppm in soils. No evidence of mortality to nontarget or target birds was observed.

It is evident from this study that even very low methiocarb levels will affect blackbird feeding behavior. It is possible that the present Borderland

Table 4. Methiocarb residues (ppm) in water samples collected during the testing of Borderland Red (1.71 oz ai/cwt), Vermillion Parish, LA. 1985.

Collection local (time)	Residue means/range (No. samples)			
	Field No. 4	Field No. 5	Field No. 6	
Field (pre-plant)	ND ^{1/}	ND	ND	(4)
Intake canal (pre-plant)	ND	ND	ND	(1)
Field (post-plant)	0.022/0.006-0.050	0.029/0.013-0.056	0.108/0.038-0.176	(3)
Field outlet (early draining)	0.052	0.039	0.071	(1)
Field outlet (late draining)	0.071	0.041	0.068/0.058-0.079	(2)
Drain canal (post-plant)	0.025/0.024-0.026	ND	0.005/ND-0.014	(6)
Primary receiving water (post-plant)	---	---	ND	(6)
Secondary receiving water (post-plant)	---	---	ND	(6)

^{1/} None detected at 0.005 ppm limit of detection.

Table 5. Methiocarb residues (ppm) in soil samples collected from fields planted with Borderland Red (1.71 oz ai/cwt) treated seed, Vermilion Parish, LA. 1985.

	Field No. 4	Field No. 5	Field No. 6
Pre-plant	ND ^{1/}	ND	ND
At planting	0.02	ND	ND
At damage assessment	0.06	ND	0.02

^{1/} None detected at 0.02 limit of detection.

Red formulation at 1.71 oz ai/cwt will provide adequate protection from black-bird depredations when used in combination with other bird control measures, or when bird pressure is low. In this study, the low methiocarb concentrations remaining on seed following field draining did not provide consistently cost-effective levels of bird repellent efficacy. Additionally, poor retention of methiocarb on seed resulted in concentrations of methiocarb in paddy and canal water which exceed the 96 hr median lethal concentrations for some aquatic organisms. Bird repellent efficacy could probably be increased and potential aquatic hazards reduced by the development of a formulation which would reduce the large losses of methiocarb from treated seed into water.

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METHIOCARB-HERBICIDE INTERACTION STUDIES

(A Progress Report)

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INTRODUCTION

Methiocarb, when properly applied as a seed treatment, protects sprouting rice from damage by blackbirds (Besser, 1973; Mott et al., 1976; Holler et al., 1985). Application of propanil to methiocarb-treated rice sometimes results in seedling burn and yield reductions (Wilson et al., 1984). Studies were conducted to evaluate the compatibility between propanil and three methiocarb-based bird repellents in both drill- and water-seeded rice.

MATERIALS AND METHODS

One-pound lots of Mars rice seed were treated with appropriate quantities of repellent by tumbling for 15 min in a jar mill seed treater.

Experiments I and II. For both studies, the experimental design was a randomized complete block with four replications. The seed treatments were 1, 2, and 4 oz ai/cwt of Mesurol No. 2 Flowable (F) (Gustafson Co.); 1, 1.71, and 3.42 oz ai/cwt of Borderland Red (Borderland Products, Inc.); and 1, 2, 4, and 10 oz ai/cwt of Mesurol 75% Seed Treater (ST) (Mobay Chemical Corp.). In Experiment I, drill-seeded plots (49 in x 16 ft; 7-in row spacing) were planted with 120 lb seed/A on May 29, 1985, and propanil was applied on June 11, at a rate of 4 lb ai/A. In Experiment II, water-seeded plots (4 x 16 ft) were hand-broadcasted with 140 lb/A of presoaked seed on June 3, 1985, and propanil (4 lb ai/A) was applied on June 20.

Experiments III and IV. Three seed treatments, 2 oz ai/cwt of each of three bird repellents, Mesurol No. 2 F, Borderland Red, and Mesurol 75% ST and two herbicides, propanil alone (3 lb ai/A) and a tank mix of propanil (3 lb ai/A) plus thiobencarb (3 lb ai/A), were evaluated in Experiments III and IV. The experimental design for both experiments was a split-plot (four replications) with seed treatments as whole plots and herbicides as subplots. In Experiment III, drill-seeded plots (49 in x 6 ft; 7-in row spacing) were planted with 120 lb seed/A on May 29, 1985, and herbicide was applied on June 11. In Experiment IV, water-seeded plots (4 x 6 ft) were hand-broadcasted with 140 lb/A of presoaked seed on June 3, 1985, and herbicide was applied on June 20.

In all experiments, plots were fertilized at a rate of 60-60-60 lb/A (N-P₂O₅-K₂O) prior to planting and 75-0-0 prelood. Stand counts and seedling burn ratings were made 4 to 6 days after herbicide application. Plots were harvested on September 18 using a small plot combine. Moisture determinations were made on all samples, and grain yields were adjusted to 11% moisture. Stand counts and yields were analyzed using an analysis of variance. Means were compared using the least significant difference (LSD) procedure.

RESULTS AND DISCUSSION

Experiment I. Moderate to severe seedling burn occurred in all methiocarb-treated plots (Table 1). Interaction of propanil with 1, 1.71, and 3.42 oz ai/cwt of Borderland Red; 2 and 4 oz ai/cwt of Mesurol No. 2 F; and 2, 4, and 10 oz ai/cwt of Mesurol 75% ST resulted in significant stand losses. Seedling injury in plots treated with Borderland Red at 3.42 oz ai/cwt, Mesurol No. 2 F at 2 and 4 oz ai/cwt, and Mesurol 75% ST at 4 and 10 oz ai/cwt was severe and resulted in yield reductions ranging from 13 to 68%.

Experiment II. Seedling burn in rice treated with 1, 1.71, and 3.42 oz ai/cwt of Borderland Red; 1, 2, and 4 oz ai/cwt of Mesurol No. 2 F; and 1, 2, and 4 oz ai/cwt of Mesurol 75% ST was minimal and similar to that in the untreated check (Table 2). Seedling injury in rice treated with 10 oz ai/cwt of Mesurol 75% ST was slightly greater than in other plots, but plants recovered within 3 weeks after propanil application. Significant stand or yield reductions were not noted where propanil was applied with any of the bird repellent treatments.

Experiment III. Moderate seedling injury and significant stand reductions occurred in all methiocarb-treated plots (Table 3). However, 4 to 5 weeks after herbicide application none of the treated plots could be distinguished from the untreated check. Significant yield reductions were not observed. No significant differences in seedling burn, stand, or yield were observed between plots treated with propanil alone and plots treated with the propanil plus thiobencarb tank mix.

Experiment IV. Seedling burn was minimal in all treated plots, and similar to that for the untreated check (Table 4). No significant reductions in stand or yield were observed in methiocarb-treated rice. Stand and yield in plots treated with propanil plus thiobencarb were similar to those in plots receiving propanil alone.

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Table 1. Effects of methiocarb-propanil interaction in drill-seeded rice.
Rice Research Station, Crowley, LA. 1985.

Treatment	Rate (oz ai/cwt)	Burn rating ^{1/}	Stand count ^{2/4/}	Yield ^{3/4/}
Borderland Red	1	5	16.6*	4505
Borderland Red	1.71	5.5	15.8**	4354
Borderland Red	3.42	8	5.5**	3672**
Mesuro1 No. 2 Flowable	1	5	17.8	4404
Mesuro1 No. 2 Flowable	2	6.75	9.7**	3902**
Mesuro1 No. 2 Flowable	4	9	3.1 **	3569**
Mesuro1 75% Seed Treater	1	5	17.5	4517
Mesuro1 75% Seed Treater	2	6.25	13.4**	4367
Mesuro1 75% Seed Treater	4	8.25	4.8**	4058**
Mesuro1 75% Seed Treater	10	10	0.9**	1509**
Check	0	1	20.5	4665

^{1/} Burn ratings were continuous from 0 to 10 (0 = no burn, 5 = moderate, and 10 = very severe burn).

^{2/} Average no. of stems/sample determined from seven 1-ft long randomly selected samples (1/drill row) in each plot.

^{3/} Grain yields adjusted to 11% moisture.

^{4/} Means followed by asterisks were significantly different from the mean for the untreated check at the 1% (**) or 5% (*) level.

Table 2. Effects of methiocarb-propanil interaction in water-seeded rice.
Rice Research Station, Crowley, LA. 1985.

Treatment	Rate (oz ai/cwt)	Burn rating ^{1/}	Stand count ^{2/}	Yield ^{3/}
Borderland Red	1	1	9.1	4165
Borderland Red	1.71	1	9.5	4036
Borderland Red	3.42	1	8.1	4172
Mesuro1 No. 2 Flowable	1	1	9.5	4041
Mesuro1 No. 2 Flowable	2	1	8.8	4215
Mesuro1 No. 2 Flowable	4	1	8.4	3905
Mesuro1 75% Seed Treater	1	1	8.0	4123
Mesuro1 75% Seed Treater	2	1	8.7	4212
Mesuro1 75% Seed Treater	4	1	8.5	4339
Mesuro1 75% Seed Treater	10	3	7.7	4294
Check	0	1	9.2	3864

^{1/} Burn ratings were continuous from 0 to 10 (0 = no burn, 5 = moderate, and 10 = very severe burn).

^{2/} Average no. of stems/subplot determined from seven randomly selected 0.34 ft² subplots in each plot.

^{3/} Grain yields adjusted to 11% moisture.

Table 3. Effects of methiocarb-herbicide interaction in drill-seeded rice. Rice Research Station, Crowley, LA. 1985.

Seed treatment	Burn rating $\frac{1}{-}$		Stand count $\frac{2}{-}$		Yield (lb/A) $\frac{3}{-}$	
	Propanil	Propanil + thiobencarb	Propanil	Propanil + thiobencarb	Propanil	Propanil + thiobencarb
Borderland Red (2 oz ai/cwt)	5	5	5	15.0	15.4*	4541
Mesurool No. 2 Flowable (2 oz ai/cwt)	5.75	5.75	5.75	15.4	14.4**	4430
Mesurool 75% Seed Treater (2 oz ai/cwt)	5.75	5.75	5.75	15.2	14.2**	4795
Check	1	1	1	16.9	17.6	4669
						4660
						4664

1/ Burn ratings were continuous from 0 to 10 (0 = no burn, 5 = moderate, and 10 = very severe burn).

2/ Average no. of stems/sample determined from seven 1-ft long randomly selected samples (1/drill row) in each plot.

3/ Grain yields adjusted to 11% moisture.

4/ Means followed by asterisks were significantly different from the mean for the untreated check at the 1% (**) or 5% (*) level.

Table 4. Effects of methiocarb-herbicide interaction in water-seeded rice. Rice Research Station, Crowley, LA. 1985.

Seed treatment	Burn rating ^{1/}		Stand count ^{2/}		Yield (lbs/A) ^{3/}			
	Propanil	Propanil + thiobencarb	Avg.	Propanil + thiobencarb	Avg.	Propanil + thiobencarb		
Borderland Red (2 oz ai/cwt)	1	1	1	8.0	8.3	4237	4401	4319
Mesuro1 No. 2 Flowable (2 oz ai/cwt)	1	1	1	7.5	7.7	4229	4286	4257
Mesuro1 75% Seed Treater (2 oz ai/cwt)	1	1	1	7.9	8.1	4245	4286	4266
Check	1	1	1	8.5	8.1	4479	4233	4356

^{1/} Burn ratings were continuous from 0 to 10 (0 = no burn, 5 = moderate, and 10 = very severe burn).

^{2/} Average no. of stems/subplot determined from seven randomly selected 0.34 ft² subplots in each plot.

^{3/} Grain yields adjusted to 11% moisture.

PLANT PHYSIOLOGY

PLANT GROWTH REGULATOR EFFECTS ON RICE^{1/}

(A Progress Report)

Richard Dunand, Martin Brunson, Russell Dilly, Jr., and Greg Meche

INTRODUCTION

Plant growth regulators (PGRs) can have a tremendous effect on crop production because of their ability to alter plant growth and development. Therefore, determination of the modifications to plant growth and development which would improve rice production and identification of the PGRs which promote those effects are necessary. At present, research in this area has shown that the modification of internode elongation can be beneficial, and PGRs have been identified which can modify internode elongation. To date, research results have shown that PGRs can modify internode elongation to reduce plant stature. In varieties susceptible to lodging because of their tall stature, reductions in plant height by PGRs have been accomplished and have resulted in a greater tolerance of these varieties to lodging. In addition, studies on modifying 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, a noxious weed, can be minimized. That response offers the potential for a control measure for established red rice in commercial rice production. In addition, a new area of interest involves rice biomass production for forage for crawfish. Along with nitrogen fertility, PGRs that promote vegetative growth and elongation will be studied to determine their effects on biomass production and persistence under a winter flood. In an effort to address the objectives of these types of studies, PGRs with potential for commercial use were tested for their effects on rice growth and development.

I. STATURE REDUCTION

XE-1019 Test

MATERIALS AND METHODS

The experiment began with preparation of a dry seedbed. Seed of Saturn, a commercial tall, lodging susceptible rice variety, and fertilizer (8-24-24 with 1.2% zinc) were separately placed below the soil surface using a small plot drill at rates of 100 and 300 lb/A, respectively. Row widths were 7 inches. Seed were planted on April 2, 1985. Emergence was observed on April 15. Propanil (3 lb ai/A) was applied for weed control at the 3- to 4-leaf stage

^{1/} This work was made possible through the financial support of the Louisiana Rice Research Board, Agricultural Products/3M, Chevron Chemical Co., Hoechst-Roussel Agri-Vet Co. and Monsanto Agricultural Products Co.

(May 9). A nitrogen topdressing of 90 lb N/A as urea (45% N) was made on May 13 and a permanent flood established on May 15. On May 24, the Saturn rice was determined to have reached the late tiller stage of growth. Metal flashings were placed to isolate plot (5 x 15 ft) areas. These areas were sprayed with XE-1019 using a backpack sprayer (CO₂ driven and 15 gal/A delivery). Furadan was applied on May 27 for water weevil control. On June 5, the Saturn rice was at the internode development stage of growth and XE-1019 treatments were imposed as previously described. On August 8, the experiment was drained for harvest. All data were collected at harvest. All plots were lodged at harvest due to a hurricane. An evaluation of the treatments before the hurricane showed the XE-1019 treatments had prevented lodging. All control plots were 100% lodged at that time. There was a factorial arrangement of treatments with a randomized complete block design and four replications.

RESULTS AND DISCUSSION

The results of the experiment are presented in Table 1. There was no significant difference between times of application (late tiller and internode formation) of XE-1019 on plant height, grain moisture, or grain yields. Rate of application of XE-1019 had a significant effect on plant height only. XE-1019 caused a decrease in plant height. Independent of time of application, plant height was reduced from a control level of 54 inches down to 43 and 40 inches for the 0.03 and 0.06 lb ai/A rates, respectively. Plant height in response to the 0.03 lb ai/A rate of XE-1019 was significantly lower than plant height in the control, and plant height in response to the 0.06 lb ai/A rate of XE-1019 was significantly lower than plant height in the plots receiving 0.03 lb ai/A of XE-1019 and no XE-1019.

Mefluidide Test

MATERIALS AND METHODS

A dry seedbed was prepared and plots were seeded with Saturn rice at the rate of 100 lb/A and fertilized with 8-24-24 with zinc (1.2%) at the rate of 300 lb/A on April 30, 1985. Plots were flush irrigated periodically to facilitate germination, emergence and seedling establishment. On May 24, Saturn plants were at the 3 to 4 leaf stage and propanil (3 lb ai/A) was applied for weed control. Plots were topdressed with urea (45% N) at the rate of 200 lb/A on May 28, and one day later flooded to a depth of 3 to 4 inches. On June 12, furadan for water weevil control was applied.

Mefluidide was applied at second tiller (June 3), first internode (June 17), and first heading (July 23) at rates of 0.0625, 0.125 and 0.25 lb/A. Observations on June 12 indicated the higher rates of mefluidide were reducing plant height in the second tiller treatments. Tiller formation appeared unaffected by the treatments. Tiller shoots were well developed and approximately 3/4 as tall as the main shoot. Observations on June 26 showed height reduction from the second tiller treatments were still apparent and height reduction was also noted at the high rate of mefluidide applied prior to internode formation. Observations were made on July 15 and height reduction was still most noticeable in the second tiller treatments. On August 2, lodging occurred and lodging ratings were made. At this time the high rate of mefluidide applied at second tiller was delaying maturity approximately 1 week. In that treatment, panicles were green and beginning to droop indicating early

Table 1. The effect of time and rate of application of XE-1019 on plant stature and grain production in rice (Oryza/sativa var. Saturn).
Rice Research Station, Crowley, LA. 1985.^{1/}

Time of application (Stage of growth)	Plant height (inches)	Grain	
		Yield (lb/A)	Moisture (%)
Late tillering	46 a	5676 a	16.8 a
Internode development	45 a	5676 a	16.4 a
 Rate of application (lb ai/A)			
0	54 a	5749 a	16.6 a
0.03	43 b	5654 a	16.8 a
0.06	40 c	5624 a	16.4 a

^{1/} Means within columns followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

grain filling. In the untreated controls panicles were beginning to turn brown and drooping completely indicating mid to late grain filling. Lodging ratings were taken again on August 6 and plant heights recorded. Hurricanes and the inclement weather associated with them caused all plots to lodge eventually and prevented harvest.

RESULTS AND DISCUSSION

The effects of mefluidide on lodging and plant height in Saturn rice are presented in Table 2. The first lodging ratings show lodging was affected primarily by mefluidide rate. Lodging was least in plots treated at rates of 0.125 and 0.25 lb ai/A. Less than 30% of the plot area was lodged. For the untreated control and low rate of mefluidide, 70% of the plot area was lodged. Lodging ratings taken later show both time and rate of mefluidide application were affecting lodging. Only the high rate of mefluidide was reducing lodging significantly and the effect of the high rate of mefluidide was more significant at the second tiller application than at the first internode or first heading application. Plant height was affected by time and rate of application also and their effects were independent. Plant height was lowest for the early heading treatments and highest for the first internode treatments. On the average, plant height for the second tiller treatments was intermediate. Plant height for the 0.0625 lb/A rate of mefluidide was not significantly different from the untreated control. Plant height was lowest at the 0.125 and 0.25 lb/A rates of mefluidide.

SUMMARY

Plant height and lodging are both reduced by XE-1019 and mefluidide. Grain moisture and grain yield are not affected by XE-1019. The ability of XE-1019 and mefluidide to place a variety like Saturn, whose only major drawback is lodging susceptibility, in a position of high productivity is apparent. All rice varieties can lodge under harsh environmental conditions. The ability of XE-1019 and mefluidide to minimize harvest losses due to lodging is possible. No direct measurement of the ability of plant growth regulators to increase yields through minimizing lodging can be made in small plot research. The straw load from lodged rice in small plots is not sufficient to affect threshing efficiency. It is clear from on-farm experience that harvest time is reduced and harvestable yields increased if lodging is minimal.

II. RED RICE SUPPRESSION

Mefluidide Test

MATERIALS AND METHODS

An area naturally infested with red rice (*Oryza sativa* L.) was selected and a dry seedbed prepared on April 9, 1985. Plots were fertilized at the rate of 150-70-70 and water seeded with germinated seed of Labelle. Rate of seeding was 135 lb/A (dry seed basis). Furadan was applied for water weevil control 5 weeks after seeding. Applications of mefluidide were timed at the early and late boot stages of growth and the 80% heading and milk stages of growth. Rates of mefluidide were 0.125, 0.25, and 0.5 lb ai/A. Each treatment was

Table 2. The effects of mefluidide on lodging and plant height in rice. Rice Research Station, Crowley, LA. 1985.^{1/}

Mefluidide application time	Mefluidide rate (lb/A)	Lodging rating ^{2/}		Plant height (cm)
		First	Second	
		-----	-----	
Second tiller	0	7	10 d	123
	0.0625	7	9 cd	120
	0.125	2	8 bcd	111
	0.25	1	2 a	105
	Mean	4	7	115 ab
Internode formation	0	7	10 d	123
	0.0625	8	10 d	122
	0.125	3	9 cd	115
	0.25	1	7 bc	112
	Mean	4	9	118 b
First heading	0	8	10 d	127
	0.0625	6	9 cd	124
	0.125	4	8 bcd	117
	0.25	2	6 b	117
	Mean	5	8	111 a
	0	7 b	10	125 b
	0.0625	7 b	9	122 b
	0.125	3 a	8	114 a
	0.25	1 a	5	111 a

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Percentage of plot area with plants leaning more than 45 degrees from a vertical position.

repeated 3 weeks after the first application with the exception of those made at milk stage. Two weeks prior to harvest, the experiment was drained. Data collected documented seedhead suppression of red rice and grain production. Experimental design was a randomized complete block with four replications. There was a factorial arrangement of the treatments.

RESULTS AND DISCUSSION

The effects of mefluidide on grain yield and moisture, Labelle panicle exertion, and lodging are presented in Table 3. Grain yield was reduced by mefluidide applied at late boot and 80% heading. The reductions were caused by the 0.25 and 0.5 lb/A rates at late boot and 0.5 lb/A rate at 80% heading. Grain moisture was not affected by mefluidide. The effect of mefluidide on panicle exertion is reflected in the panicle suppression results. The percentage of Labelle shoots which did not have a completely exerted panicle was lowest in the untreated controls and in the 80% heading and milk stage treatments. At the early boot stage application, Labelle suppression increased with increasing rate of mefluidide until the 0.25 lb/A rate. For the late boot and milk stage application times, Labelle panicle suppression was equally affected by all mefluidide rates. For the 80% heading time of application Labelle panicle suppression was similar for the 0.125 and 0.25 lb/A rates and highest for the 0.5 lb/A rate. Lodging was equally low for all rates of mefluidide at the early and late boot treatments and at the 0.25 and 0.5 lb/A rates at the 80% heading treatment. Lodging was equally high in the untreated controls and remaining mefluidide treatments.

Grain yield, Labelle suppression, and lodging were similarly affected by mefluidide. Labelle suppression, where highest, affected panicle exertion and consequently grain production and plant height. Both of these factors are related to grain yield and lodging. Consequently, the mefluidide treatments which caused significantly high Labelle suppression also exhibited low grain yields and lodging.

The effects of mefluidide on panicle exertion of the primary growth of the main shoot of red rice are presented in Table 4. The percentage of main shoots of red rice with panicles suppressed to any degree was affected primarily by mefluidide rate. More than 95% of the shoots had suppressed panicles when treated with mefluidide at or above the 0.125 lb/A rate. The percentage of main shoots with panicles completely suppressed (did not exert the boot) was affected by both time and rate of mefluidide application. For mefluidide applied at late boot (Labelle), the percentage of red rice shoots with totally suppressed panicles increased above the untreated control with increasing rates of mefluidide until the 0.25 lb/A rate and above. The percentage of red rice main shoots with panicles partially suppressed (less than completely exerted) was lower for the early and late boot treatments compared to the 80% heading and milk stage treatments. Mefluidide rate also affected partial panicle suppression. Partial red rice panicle suppression was highest at the 0.125 lb/A rate and lowest in the untreated controls. The percentage of shoots with no panicle suppression was highest in the untreated controls and equally low at the three rates of mefluidide.

Table 3. The effect of mefluidide used for seedhead suppression of red rice on agronomic factors associated with rice production. Rice Research Station, Crowley, LA. 1985.^{1/}

Mefluidide application time ^{2/}	Mefluidide rate (lb/A)	Grain		Labelle suppression (%)	Lodging ^{3/} (%)
		Yield (lb/A)	Moisture (%)		
Early boot	0	3218 abc	33.7	1 a	8 bc
	0.125	3309 abc	35.6	3 c	2 a
	0.25	2879 abc	34.5	4 d	1 a
	0.50	2458 a	36.1	4 d	1 a
	Mean	2966	35.4	3	3
Late boot	0	3746 c	35.9	1 a	6 bc
	0.125	3190 abc	36.1	4 d	1 a
	0.25	2357 a	34.8	4 d	1 a
	0.50	2380 a	34.2	4 d	1 a
	Mean	2918	34.4	3	2
80% heading	0	3527 bc	35.1	1 a	9 c
	0.125	3177 abc	34.2	2 b	7 bc
	0.25	2524 ab	35.9	2 b	1 a
	0.50	2383 a	36.3	4 d	1 a
	Mean	2903	35.4	2	4
Milk stage	0	3736 c	35.1	1 a	9 bc
	0.125	3497 bc	35.6	2 bc	7 bc
	0.25	3563 c	36.4	2 bc	8 bc
	0.50	3618 c	31.9	3 c	6
	Mean	3603	34.8	2	7
	0	3556	35.4	1	8
	0.125	3293	34.6	3	4
	0.25	2830	35.4	3	3
	0.50	2710	34.6	4	2

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

^{3/} Percentage of plot area with plants leaning more than 45 degrees from a vertical position.

Table 4. Field evaluation of the effects of mefluidide used for seedhead suppression of red rice on red rice primary growth panicle suppression. Rice Research Station, Crowley, LA. 1985.^{1/}

Mefluidide application time ^{2/}	Mefluidide rate (lb/A)	Panicle suppression	Degree of panicle suppression		No
			Total	Partial	
			-----%		
Early boot	0	28	1 a	27	72
	0.125	94	27 b	67	6
	0.25	99	55 c	44	1
	0.50	100	69 c	31	0
	Mean	80	38	42 a	20
Late boot	0	34	0 a	34	66
	0.125	96	59 c	38	4
	0.25	100	67 c	33	0
	0.50	100	67 c	32	<1
	Mean	82	48	34 a	18
80% heading	0	45	2 a	42	55
	0.125	100	5 a	95	<1
	0.25	99	14 ab	86	1
	0.50	98	24 ab	74	2
	Mean	85	11	74 b	15
Milk stage	0	51	<1 a	50	49
	0.125	94	1 a	93	6
	0.25	94	9 a	86	6
	0.50	99	12 a	87	1
	Mean	84	6	79 b	16
	0	39 a	1	38 a	61 b
	0.125	96 b	23	73 c	4 a
	0.25	98 b	36	62 bc	2 a
	0.50	98 b	43	56 b	1 a

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

These results show that red rice is sensitive to mefluidide when applied during and after booting of a very early maturing variety and at rates above 0.125 lb/A. Red rice at this time is in the preboot or earlier stages of growth. The sensitivity of red rice is expressed as panicle suppression. There are three degrees roughly of panicle suppression. They are total, partial, and no panicle suppression and are related to the extent to which the panicle exserts the sheath of the flag leaf. The later the time of application the less complete panicle suppression is and the more partial panicle suppression occurs. The occurrence of panicle suppression in red rice due to mefluidide is rate dependent below 0.5 lb/A.

The effect of mefluidide on red rice seed production and panicle development is presented in Table 5. Red rice main shoot seed production was lowest when mefluidide was applied at the early and late boot stages of growth of Labelle. There were no significant differences between the 0.125, 0.25, and 0.5 lb/A rates of mefluidide at each application time. Floret production and panicle length were similarly affected. The only difference was the 0.5 lb/A rate was the only rate of mefluidide which had significantly lower floret production than the untreated controls. Empty florets and exserted panicle length were affected by rate of mefluidide only. All rates of mefluidide increased empty florets equally above the untreated control and exserted panicle length decreased as mefluidide rate increased with no difference in response for the two highest rates of mefluidide.

The influence of mefluidide on seed production of red rice was related to the influence of mefluidide on panicle development in general. Seed production is dependent on floret production and the fertility of these florets and their ability to fill and produce seed. Mefluidide decreased panicle length indicating that normal panicle development was interrupted. The results in Table 4 show that this resulted in few florets being produced. Also mefluidide limited panicle exsertion causing florets on all or part of the panicles to remain enclosed in the sheath of the flag leaf. In rice, florets which are kept enclosed within the sheath of the flag leaf do not pollinate well and consequently do not produce seed. These results show mefluidide reduces red rice seed production directly and indirectly through limiting the production of florets and increasing the number of unfilled florets.

Amidochlor Test

MATERIALS AND METHODS

A dry seedbed was prepared on April 30, 1985 with a disc and cultipacker. At that time the presence of red rice in the experiment was apparent by a uniform stand of red rice seedlings at the 1- to 2-leaf stage. The majority of these seedlings were destroyed during seedbed preparation. Using a drill, plots were fertilized with 8-24-24 Zn (1.2%) at the rate of 300 lb/A and urea (45% N) at the rate of 200 lb/A. On May 2, plots (5 x 15 ft) were isolated with metal flashing and flooded. Seed of Labelle (very early maturing variety) were germinated for water seeding by soaking for 16 hours in water and removing the water and letting the seed stand, remaining moist for 24 hours. On May 3, plots were seeded at the rate of 135 lb/A dry Labelle seed basis. Three days later the flood was removed to allow rooting into the soil for anchorage. On May 10, a shallow (1- to 2-inch) flood was established. On May 27 again the experiment was drained and on the following day propanil (3 lb

Table 5. The effect of mefluidide used for seedhead suppression of red rice on red rice main shoot primary panicle development and seed production. Rice Research Station, Crowley, LA. 1985.^{1/}

Mefluidide application time ^{2/}	Mefluidide rate (lb/A)	Seed production (seed/panicle)	Floret production (florets/panicle)	Empty florets (%)	Panicle length (mm)	Exserted panicle length (%)
Early boot	0	104	136	21	251	100
	0.125	42	80	45	166	58
	0.25	41	62	38	156	43
	0.50	33	68	30	120	53
	Mean	55 a	86 a	33	173 a	63
Late boot	0	91	112	19	246	94
	0.125	49	100	53	174	95
	0.25	51	112	57	158	57
	0.50	29	72	42	124	44
	Mean	55 a	99 a	43	175 a	73
80% heading	0	106	135	22	262	97
	0.125	86	124	33	220	63
	0.25	94	135	33	224	77
	0.50	38	116	63	194	64
	Mean	81 b	128 b	38	224 b	75
Milk stage	0	105	138	23	257	100
	0.125	97	130	25	244	78
	0.25	52	117	57	245	61
	0.50	80	136	45	246	48
	Mean	84 b	130 b	37	248 b	72
	0	101 b	130 b	21 a	254 b	98 c
	0.125	69 a	109 ab	39 b	200 a	73 b
	0.25	60 a	107 ab	46 b	196 a	59 a
	0.50	45 a	98 a	45 b	171 a	52 a

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

ai/A) was applied for weed control. On May 30, a flood was reestablished and a permanent flood depth of 3 to 4 inches maintained for the remainder of the growing season. On June 12, a preliminary evaluation of red rice stand was 1 plant/ft² which was determined to be excellent for the purposes of this experiment. On July 8, Labelle plants were observed for stage of growth. Most plants were at early to late boot with an occasional plant at preboot or first heading. The next day amidochlor was applied with salt-shaker type dispensers on the designated plot areas at rates of 0.75, 1.5, and 3 lb/A. One week after application the late boot treatments were observed to be affecting panicle exsertion of Labelle. At this time, plots which had not received amidochlor were heading (Labelle) noticeably with some anthesis while the Labelle plants which had been exposed to amidochlor were showing only an occasional panicle. The effects of rate were apparent. At the 0.75 lb/A rate of amidochlor, there was more heading than at the 3 lb/A rate. At this time red rice was still prebooting. On July 16, the 80% heading time of application treatments of amidochlor were applied. Labelle was approximately 80% headed (8 of 10 stems had panicles at various stages of exsertion). All main shoots observed had panicle exsertion and 80 to 90% of the tillers had panicle exsertion. No red rice plants were heading in the plots receiving amidochlor at this time and only one red rice panicle was observed in the remaining untreated plots of the experiment. The stage of growth of most of the red rice was preboot to early boot with a few at late boot. On July 23, the milk stage time of application treatments of amidochlor were applied. All Labelle plants receiving the milk stage treatments were completely headed. Most panicles had completely pollinated and some panicles were filling (milky substance noted inside the uppermost florets). Red rice was beginning to head (approximately 5% heading). On July 30, the dough stage time of application treatments of amidochlor were applied. There was active grain filling of Labelle and the uppermost florets on panicles contained endosperm with a bread dough consistency. Heading in red rice was 80 to 90% complete with a few tiller shoots at early and late boot. Plant development at the times of application was documented and is presented in Appendix 1.

General observations of early treatment times at the end of July indicated amidochlor was affecting panicle exsertion. In the late boot treatments panicle suppression was greatest compared to the other treatment times. The effects were rate dependent with the 3 lb/A rate causing the highest suppression. Red rice was suppressed more than the Labelle. This was true for all treatment times. The effect of amidochlor on both species of rice was less at the later treatment times. Panicle exsertion in Labelle was affected primarily at the late boot treatment time and panicle exsertion in red rice was affected in all but the last treatment time. In the late boot treatments secondary growth was noted at this time. Secondary growth was observed as growth originating from stem nodes on the primary shoot of the main and tiller shoots of both red rice and Labelle plants which had amidochlor suppressed original growth panicles. The secondary growth appeared as new dark green leaves emerging from between the sheaths of older mature leaves and the stem. This growth originated at the base of these older leaves. On August 5, secondary growth was first observed in the 80% heading time of application treatments mainly on red rice. On August 14, secondary growth in the late boot treatments was headed and in the 80% heading treatments secondary growth was starting to head.

Appendix 1. Rice heading status and stem development at time of application of for seedhead suppression of red rice. Rice Research Station, Crowley, LA. 1985.

Amidochlor application time ^{1/}	Heading (%)	Length						
		Panicle	Stem	Internode ^{2/}				
				1	2	3	4	5
				-----mm-----				
A. Red rice								
Late boot	0	4	190	63	107	18	2	0
80% heading	0	114	373	64	138	129	40	2
Milk stage	0	240	575	64	146	217	120	28
Dough stage	100	279	1066	75	155	245	257	334
B. Labelle								
Late boot	0	198	293	17	82	137	42	15
80% heading	97	208	790	19	92	198	179	302
Milk stage	100	214	920	14	82	189	235	400
Dough stage	100	209	920	17	88	196	231	388

^{1/} Based on the growth stage of the rice cultivar.

^{2/} Number assignment is acropetal.

Internode number five is directly below the panicle.

On August 23, the experiment was terminated. Plots were evaluated for seedhead suppression of red rice and Labelle rice, and individual plants of red rice and Labelle were sampled for analysis of amidochlor effects on plant growth and development. Lodging occurred due to hurricane force winds, and since plant height had been affected by amidochlor, an evaluation of lodging was made. Plots were then combine harvested and grain moisture and yield determined. Following harvest on August 29, Centennial soybeans were broadcast on the surface of each plot to determine residual effects of amidochlor. Heavy rains and poor drainage following seeding resulted in standing water for several days. Consequently, stands were very poor to non-existent and no evaluations were made.

Experimental design was a randomized complete block with four replications. Treatments were arranged factorially. In some cases subsampling was used.

RESULTS AND DISCUSSION

Field Evaluations

The effects of amidochlor used for seedhead suppression of red rice on agronomic factors associated with rice production are presented in Table 6. Grain moisture and yield results are quantitative while the other variables presented were based on subjective evaluation. Grain moisture was slightly higher in the late boot treatment and at the 0.75 and 1.5 lb/A rates of amidochlor. Grain yield was higher at the 80% heading and milk stage times of application. Lodging was greatest in the control plots and in the milk and dough stage times of application. At the late boot and 80% heading, times of application lodging and rate of application of amidochlor were inversely related. Labelle suppression was similarly affected. There was no suppression of Labelle in the control plots and for the milk and dough stage times of application. Secondary growth in red rice initiated by the application of amidochlor was lowest in the control plots which received no amidochlor and in the dough stage time of application in which amidochlor was applied after heading of red rice. In the late boot and 80% heading times of application, secondary growth was high (averaging secondary growth on almost every plant) at all rates of amidochlor. Only at the milk stage time of application was secondary growth dependent on rate of amidochlor application. The maturity of secondary growth was related mainly to time of application. The earlier the application of amidochlor was made the earlier secondary growth was initiated and the later in maturity was the secondary growth at harvest.

The effects of amidochlor on grain moisture and yield were related to the effects of amidochlor on the other agronomic factors presented. Suppression of Labelle by the late boot application delayed its maturity and with the late maturity of the red rice secondary growth contributed to higher grain moisture of the harvested grain. The effects of rate of application of amidochlor on grain moisture can be explained in a similar manner. Grain yield was lower with the late boot application because suppression of Labelle was high with that treatment. Since lodging is related to plant height, the affect of amidochlor on reducing plant height was apparent from the Labelle suppression results and explains the effects of time and rate of application of amidochlor on lodging.

Table 6. The effect of amidochlor used for seedhead suppression of red rice on agronomic factors associated with rice production. Rice Research Station, Crowley, LA. 1985.

Amidochlor application time	Amidochlor rate (lb/A)	Grain		Lodging	Labelle suppression	Red rice regrowth
		Moisture (%)	Yield (lb/A)	(%)	(%)	Amount (%) Maturity
Late boot	0	19.6	6487	85 e	0 a	0 a
	0.75	21.0	6398	38 bc	25 cd	95 f
	1.50	21.5	6323	0 a	85 e	100 f
	3.00	20.4	4255	0 a	98 f	100 f
	Mean	20.6 b	5866 a	31	52	74
80% heading	0	19.5	7792	80 e	0 a	0 a
	0.75	20.4	6799	52 cd	15 bc	98 f
	1.50	20.0	7134	32 b	28 cd	100 f
	3.00	20.1	6410	10 a	38 d	95 f
	Mean	20.0 a	7034 b	44	20	73
Milk stage	0	19.8	6845	85 e	0 a	0 a
	0.75	19.7	7401	70 e	10 ab	38 c
	1.50	20.1	6488	72 e	0 a	60 d
	3.00	19.5	6873	68 de	0 a	80 e
	Mean	19.8 a	6902 b	74	2	44
Dough stage	0	19.6	6404	82 e	0 a	0 a
	0.75	19.8	6661	82 e	0 a	0 a
	1.50	19.5	6200	82 e	0 a	10 a
	3.00	19.7	7513	80 e	0 a	18 ab
	Mean	19.7 a	6694 ab	82	0	7
	0	19.6 a	6882	83	0	0
	0.75	20.2 b	6815	60	12	58
	1.50	20.3 b	6536	46	28	68
	3.00	19.9 ab	6263	40	34	73

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

2/ Based on the growth stage of the rice cultivar.

3/ Percentage of plot area with plants leaning more than 45 degrees from a vertical position.

4/ Percentage of plants with panicle suppression.

5/ Percentage of plants with regrowth.

6/ B = before boot, L = late boot, H = heading, A = anthesis, P = post anthesis, and M = milk stage.

The effects of amidochlor on red rice panicle suppression are presented in Table 7. These results were obtained in the field based on observations made on 10 red rice plants per plot. The number of stems (main and tiller) of red rice with panicle exertion affected to any degree by amidochlor was affected by both time and rate of application. The effect was almost complete for all rates of amidochlor at the late boot, 80% heading, and milk stages of application. Only at the dough stage of application was seedhead suppression statistically less than complete averaging about 50%. Seedhead suppression was expressed in primarily two ways. Either the panicle was totally suppressed not exerting the boot at all or the panicle was partially suppression with less than 90% of the total panicle length exerting the boot. Total panicle suppression was greatest with the late boot, 80% heading, and milk stage times of application. The effect was rate dependent with the effect of rate decreasing with later times of application. Partial panicle suppression was affected by amidochlor in a fashion opposite that of total panicle suppression. Partial panicle suppression was greatest at the dough stage time of application and least at the late boot time of application and highest at the lowest rate of application. The degree to which the partially suppressed panicles exerted the boot was affected by amidochlor in a manner similar to the effects of amidochlor on partial panicle suppression.

The results on total and partial panicle suppression and degree exertion of partially suppressed panicles are related to the stage of growth of red rice at the time of application of amidochlor. At the late boot and 80% heading stages of growth of Labelle, red rice was at the prebooting stage of growth which is a sensitive stage of growth to seedhead suppressants. At the later stages of growth, the red rice was more advanced in development, and at the dough stage of Labelle, red rice was heading and less sensitive to seedhead suppressant activity.

Individual Plant Evaluation

Red Rice

The effects of amidochlor on red rice main shoot seed production are presented in Table 8. These results were obtained on two red rice plants from each plot. Total seed production was the sum of seed production on the primary growth plus seed production on the secondary growth resulting from the application of amidochlor. Total red rice seed production was reduced by the late boot and 80% heading times of application. Reduction was greater with the late boot treatments. The effect was also rate dependent with the 3 lb/A rate reducing red rice seed production most. At the late boot time of application and the 3 lb/A rate of application, red rice seed production was reduced approximately 95% compared to the control. The majority of the red rice seed production was on the primary growth and consequently the results of the effects of amidochlor on primary growth seed production are similar to those on total seed production. Secondary growth seed production was highest with the late boot time of application which was expected based on the secondary growth maturity evaluation presented in Table 6.

The effects of amidochlor on red rice seed production are in close agreement with the field evaluation of seedhead suppression in Table 7. Amidochlor treatments which had the greatest seedhead suppression resulted in red rice plants with the least seed production. In rice, pollination is

Table 7. Field evaluation of the effects of amidochlor used for seedhead suppression of red rice on red rice primary growth panicle suppression. Rice Research Station, Crowley, LA. 1985.^{1/}

Amidochlor application time ^{2/}	Amidochlor rate (lb/A)	Panicle suppression (%)	Panicle suppression		Partial panicle suppression degree (%)
			Total (%)	Partial (%)	
Late boot	0	12 a	3 a	8 a	15 abc
	0.75	88 c	81 de	7 ab	7 ab
	1.50	100 c	98 ef	2 a	<1 a
	3.00	100 c	100 f	0 a	0 a
	Mean	75	70	4	4
80% heading	0	19 a	<1 a	19 abc	24 cde
	0.75	91 c	61 c	30 bc	18 bcd
	1.50	96 c	75 cd	21 abc	13 abc
	3.00	99 c	91 def	9 ab	7 ab
	Mean	76	57	20	16
Milk stage	0	21 a	0 a	21 abc	22 bcd
	0.75	87 c	12 a	75 e	43 g
	1.50	98 c	43 b	55 cde	26 c-f
	3.00	100 c	36 b	64 de	25 c-f
	Mean	76	23	54	29
Dough stage	0	14 a	0 a	14 ab	21 bcd
	0.75	53 b	<1 a	53 cde	41 fg
	1.50	58 b	5 a	54 cde	32 d-g
	3.00	50 b	8 a	42 cd	39 efg
	Mean	44	4	41	34
	0	16	1	16	20
	0.75	80	39	41	27
	1.50	88	55	33	18
	3.00	87	59	29	18

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

Table 8. The effect of amidochlor used for seedhead suppression of red rice on main shoot seed production of red rice infesting commercial rice.
Rice Research Station, Crowley, LA. 1985.^{1/}

Amidochlor application time ^{2/}	Amidochlor rate (lb/A)	Seed production				
		Total	Primary	Secondary		
				Total	First	Second
-----seed/panicle-----						
Late boot	0	110 f	110 g	0	0	0
	0.75	70 cde	59 c-f	11	11	0
	1.50	36 abc	22 abc	14	14	0
	3.00	5 a	5 a	<1	<1	0
	Mean	55	49	6 b	6 b	0
80% heading	0	102 ef	102 g	0	0	0
	0.75	55 bcd	47 b-e	8	3	5
	1.50	44 bcd	41 a-d	3	2	1
	3.00	14 ab	12 ab	2	2	>1
	Mean	54	51	3 ab	2 ab	1
Milk stage	0	84 def	84 efg	0	0	0
	0.75	98 ef	98 fg	0	0	0
	1.50	83 def	83 efg	<1	<1	0
	3.00	79 def	79 d-g	0	0	0
	Mean	86	86	<1 a	<1 a	0
Dough stage	0	117 f	117 g	0	0	0
	0.75	102 ef	102 g	0	0	0
	1.50	108 f	108 g	0	0	0
	3.00	100 ef	100 fg	0	0	0
	Mean	107	107	0 a	0 a	0
	0	103	103	0	0	0
	0.75	81	77	5	4	1
	1.50	68	63	4	4	<1
	3.00	50	49	1	1	<1

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

restricted in florets which are confined in the boot and consequently seed production is reduced by seedhead suppressant action.

The effects of amidochlor on red rice main shoot primary panicle development are presented in Table 9. The percentage of empty florets or those which did not produce a seed was highest in the late boot and 80% heading treatments and at the higher rates of amidochlor. The number of florets per panicle as estimated by the number of pedicels per panicle was lower in the late boot and 80% heading treatments and was lowest at the highest rate of amidochlor. Similar effects were noted on total panicle length and exerted panicle length.

The reduction in floret number, panicle length, and panicle exertion and increase in empty florets due to the application of amidochlor indicate the effect of amidochlor on seed production (Table 8) were related to the effects of amidochlor on panicle development as well as the effects of amidochlor on panicle exertion (Tables 7 and 9). These results also indicate that amidochlor can have a direct affect on panicle development and limit seed production directly in addition to having an indirect affect on seed production related to panicle suppression.

The effects of amidochlor on red rice main shoot weight are presented in Table 10. The dry weight of main shoots was increased by the application of amidochlor in the late boot and 80% heading treatments. These results were due to the secondary growth which occurred following amidochlor application. Secondary growth on the main shoots of red rice was greatest in the late boot and 80% heading treatments. Most of the secondary growth weight occurred with the secondary growth that originated lowest on the stem (first). The first secondary growth was more fully developed than the secondary growth that originated second or third on the main shoot.

In addition to shoot weight, amidochlor affected red rice stem elongation. These results are presented in Table 11. Stem length was shortened by amidochlor applications at the late boot, 80% heading, and milk stage times of application. Also, stem length decreased with increasing rates of amidochlor. Lengths of individual internodes which comprise the stem were affected differently by time and rate of amidochlor applications. In general, the late boot and 80% heading treatments of amidochlor affected more internodes than any other treatment. Of the five upper stem internodes on the main shoot of red rice, the fourth and fifth internodes were affected consistently by amidochlor time and rate of application. The lengths of the fourth and fifth internodes were shortest in the late boot, 80% heading, and milk stage treatments. The 0.75 and 1.5 lb/A rates of amidochlor were equally effective in reducing the lengths of the fourth and fifth internodes below the control and the 3 lb/A rate reduced internode length even more.

The results on stem and internode length indicate that the ability of amidochlor to cause seedhead suppression in red rice is through the ability of amidochlor to affect stem elongation. The most significant effects were associated with the fourth and fifth internodes. The fourth and fifth internodes account for approximately 40 to 60% of the total stem length in rice and their elongation is responsible for moving the panicle out of the sheath of the flag leaf during heading. It is therefore through the direct effects of amidochlor on internode elongation that seedhead suppression and to some degree the associated reduction in red rice seed production is accomplished.

Table 9. The effect of amidochlor used for seedhead suppression of red rice on red rice main stem primary panicle development. Rice Research Station, Crowley, LA. 1985.^{1/}

Amidochlor application time ^{2/}	Amidochlor rate (lb/A)	Empty florets (%)	Panicle length (mm)	Pedicles (pedicles/panicle)	Exserted panicle length (mm)
Late boot	0	8 a	254 de	121	248
	0.75	28 abc	208 cd	83	208
	1.50	67 e	213 cde	65	178
	3.00	65 de	134 ab	36	96
	Mean	42	202	76 a	183 b
80% heading	0	6 a	250 de	110	235
	1.75	39 bc	168 bc	71	124
	1.50	41 cd	180 bc	74	144
	3.00	68 e	120 a	39	75
	Mean	38	180 bc	73 a	145 a
Milk stage	0	3 a	260 e	114	260
	0.75	18 abc	253 de	118	200
	1.50	15 ab	236 de	100	180
	3.00	23 abc	240 de	103	115
	Mean	16	246 de	109 b	184 b
Dough stage	0	7 a	265 e	128	255
	0.75	10 a	250 de	113	226
	1.50	8 a	256 de	117	227
	3.00	8 a	250 de	108	190
	Mean	8	255	116 b	224 c
	0	6	257	118 c	249 c
	0.75	24	220	96 b	190 b
	1.50	33	221	89 b	182 b
	3.00	41	186	72 a	119 a

^{1/} Means within a column followed by the same letter are not significantly different ($P = 0.05$) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

Table 10. The effect of amidochlor used for seedhead suppression of red rice on red rice main shoot primary and secondary growth weight. Rice Research Station, Crowley, LA. 1985.^{1/}

Amidochlor application time ^{2/}	Amidochlor rate (lb/A)	Stem dry weight					
		Total	Primary	Secondary			
				Total	First	Second	Third
-----g/stem-----							
Late boot	0	3.43	3.31	0.12 ab	0.06 a	0.06	0.00
	0.75	4.58	3.55	1.03 a-d	0.94 bc	0.09	0.00
	1.50	4.87	3.04	1.83 de	1.42 c	0.30	0.11
	3.00	3.44	3.04	0.40 ab	0.32 a	0.08	0.00
	Mean	4.08 b	3.23	0.85	0.68	0.14 a	0.03
80% heading	0	3.39	3.28	0.11 ab	0.11 a	0.00	0.00
	0.75	4.70	2.85	1.84 de	1.13 c	0.71	0.00
	1.50	4.77	2.64	2.13 e	1.42 c	0.56	0.15
	3.00	4.24	2.59	1.65 cde	1.18 c	0.46	0.00
	Mean	4.27 b	2.84	1.43	0.96	0.43 b	0.04
Milk stage	0	3.34	3.34	0.00 a	0.00 a	0.00	0.00
	0.75	4.03	3.45	0.58 ab	0.33 a	0.25	0.00
	1.50	3.76	3.00	0.76 abc	0.51 ab	0.25	0.00
	3.00	3.71	2.65	1.06 bcd	0.47 ab	0.37	0.22
	Mean	3.73 ab	3.09	0.64	0.35	0.23 ab	0.05
Dough stage	0	3.46	3.41	0.05 ab	0.05 a	0.00	0.00
	0.75	3.46	3.34	0.12 ab	0.12 a	0.00	0.00
	1.50	3.34	3.34	0.00 a	0.00 a	0.00	0.00
	3.00	3.19	3.04	0.15 ab	0.10 a	0.05	0.00
	Mean	3.36 a	3.28	0.08	0.07	0.01 a	0.00
	0	3.41	3.24	0.08	0.06	0.02	0.00
	0.75	4.19	2.41	0.89	0.63	0.26	0.00
	1.50	4.21	1.78	1.22	0.86	0.29	0.06
	3.00	3.64	2.01	0.82	0.52	0.24	0.05

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

Table 11. The effect of amidochlor used for seedhead suppression of red rice on red rice main stem elongation. Rice Research Station, Crowley, LA. 1985.^{1/}

Amidochlor application time ^{2/}	Amidochlor rate (lb/A)	Length ^{3/}					
		Stem	Internode				
			1	2	3	4	5
-----mm-----							
Late boot	0	1159	113	211 d	255 de	246	334
	0.75	1038	180	152 abc	161 abc	240	306
	1.50	874	179	98 a	139 ab	189	269
	3.00	583	128	103 a	100 a	117	134
	Mean	914 a	150 b	141	164	198 b	261 a
80% heading	0	1184	140	216 d	257 de	238	332
	0.75	767	103	171 bcd	132 ab	141	221
	1.50	703	101	121 ab	117 a	139	225
	3.00	600	114	139 abc	121 a	88	138
	Mean	813 a	114 a	162	157	152 a	229 a
Milk stage	0	1131	86	173 bcd	248 de	265	359
	0.75	854	78	156 a-d	192 bcd	131	296
	1.50	868	82	186 bcd	202 cde	129	269
	3.00	763	89	187 cd	219 cde	136	133
	Mean	889 a	84 a	176	213	158 a	258 a
Dough stage	0	1192	117	189 cd	266 e	262	358
	0.75	1133	100	200 cd	253 de	253	328
	1.50	1080	90	196 cd	254 de	240	300
	3.00	976	94	185 bcd	215 cde	200	282
	Mean	1095 b	100 a	192	247	239 c	317 b
	0	1169 c	116	199	257	252 c	345
	0.75	948 b	115	170	185	191 b	288
	1.50	881 b	113	150	178	174 b	266
	3.00	731 a	106	154	164	135 a	172

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

^{3/} Number assignment is acropetal.
Internode number five is directly below the panicle.

Following examination of the effects of amidochlor on main shoot development in red rice, the effects of amidochlor on panicle exertion of secondary growth were studied. The results are presented in Table 12. Secondary growth as previously noted was highest for the late boot and 80% heading treatments. For all rates of amidochlor there was secondary growth on almost every plant, and the number of secondary growth stems with panicle exertion to any degree by maturity of the crop was almost 100%. The number of secondary growth panicles completely exerted was highest for the late boot application of amidochlor and the 0.75 and 1.5 lb/A rates. Partial panicle exertion was equally high (statistically) for the late boot and 80% heading application times. Similar results were noted for the degree of partial panicle exertion out of the boot for red rice secondary growth.

The results on panicle exertion of red rice secondary growth show that early applications of amidochlor enhance the possibility of complete secondary growth development to heading. This increases the chances that secondary growth can produce seed after primary growth has been terminated by amidochlor application. These results are in agreement with those in Table 6 showing the field evaluation of secondary growth maturity and in Table 8 showing secondary growth seed production.

Labelle

The effects of amidochlor used for seedhead suppression of red rice on Labelle main shoot grain production are presented in Table 13. Grain production expressed as g/panicle and grains/panicle was affected similarly by amidochlor. Grain production was reduced significantly by the 3 lb/A rate of amidochlor applied at the late boot stage of growth. In part, this was due to the effect of amidochlor on individual grain weight. Individual grain weight was low for the 3 lb/A, late boot amidochlor treatment. The effects of amidochlor on grain production were related to the effects of amidochlor on panicle development. Results in Table 14 show that although total floret production (florets/panicle) and panicle length were not affected by amidochlor, amidochlor treatments did affect the percentage of empty florets and panicle exertion. Empty florets were 54% of the total florets produced for Labelle plants receiving amidochlor at the 3 lb/A rate during the late boot stage of growth. For this same treatment only 43% of the total length of the panicle on the main shoot exerted the boot.

These results show that amidochlor application before heading can prevent exertion of the panicle of rice cultivars. This results in reduced yields, floret infertility, and incomplete grain fill (low individual grain weight).

As with red rice, the effects of amidochlor on panicle exertion of Labelle were due directly to the effects of amidochlor on stem elongation. These results are presented in Table 15. For the late boot treatment, stem length was inversely related to rate of amidochlor. For the 80% heading treatment, amidochlor reduced stem length but the effect was not rate dependent as for the late boot treatment. There was no effect of amidochlor on stem elongation when applied at the milk and dough stages since stem elongation was essentially complete. The second through the fifth internodes were affected by amidochlor applied at the late boot and 80% heading stages of growth. For the second internode, there was no difference between internode lengths for the

Table 12. The effect of amidochlor used for seedhead suppression of red rice on red rice secondary main stem panicle production. Rice Research Station, Crowley, LA. 1985.^{1/}

Amidochlor application time ^{2/}	Amidochlor rate (lb/A)	Regrowth panicle production (stems/plants)	Panicle exertion (%)	Panicle exertion		Partial panicle exertion degree (%)
				Total (%)	Partial (%)	
Late boot	0	>1 a	2 a	2 a	0 a	0 a
	0.75	9 ab	90 c	54 b	36 bc	37 bc
	1.50	11 b	100 c	50 b	50 bc	41 c
	3.00	7 ab	90 c	17 a	73 bc	39 bc
80% heading	0	0 a	0 a	0 a	0 a	0 a
	0.75	10 b	100 c	16 a	83 c	42 c
	1.50	12 b	100 c	9 a	91 c	51 c
	3.00	8 ab	82 bc	15 a	67 bc	30 abc
Milk stage	0	0 a	0 a	0 a	0 a	0 a
	0.75	1 a	15 ab	4 a	11 a	6 ab
	1.50	4 a	55 abc	4 a	51 bc	19 abc
	3.00	1 a	20 ab	0 a	20 b	7 ab
Dough stage	0	0 a	0 a	0 a	0 a	0 a
	0.75	0 a	0 a	0 a	0 a	0 a
	1.50	0 a	0 a	0 a	0 a	0 a
	3.00	0 a	2 a	0 a	2 a	1 a

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

Table 13. The effect of amidochlor used for seedhead suppression of red rice on rice cultivar main shoot grain production. Rice Research Station, Crowley, LA. 1985.^{1/}

Amidochlor application time ^{2/}	Amidochlor rate (lb/A)	Grain yield		Individual grain weight (mg)
		(g/panicle)	(grains/panicle)	
Late boot	0	1.64 bcd	92 bcd	18 b
	0.75	1.49 bcd	86 bcd	17 b
	1.50	1.06 b	84 bc	16 b
	3.00	0.43 a	51 a	8 a
	Mean	1.15	78	15
80% heading	0	1.19 bc	71 abc	16 b
	0.75	1.95 d	107 cd	18 b
	1.50	1.54 bcd	92 bcd	17 b
	3.00	1.37 bcd	87 bcd	16 b
	Mean	1.51	89	17
Milk stage	0	1.20 bc	82 bc	14 b
	0.75	1.87 cd	116 d	16 b
	1.50	1.84 cd	104 cd	18 b
	3.00	1.70 bcd	97 bcd	17 b
	Mean	1.68	101	17
Dough stage	0	1.82 cd	108 cd	17 b
	0.75	1.30 bcd	77 abc	17 b
	1.50	1.54 bcd	92 bcd	17 b
	3.00	1.55 bcd	88 bcd	18 b
	Mean	1.55	91	17
	0	1.48	89	16
	0.75	1.65	96	17
	1.50	1.50	93	17
	3.00	1.26	81	15

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

Table 14. The effect of amidochlor used for seedhead suppression of red rice on rice cultivar main shoot panicle development. Rice Research Station, Crowley, LA. 1985.^{1/}

Amidochlor application time ^{2/}	Amidochlor rate (lb/A)	Floret production		Panicle length (mm)	Panicle exertion (%)
		Total (florets/panicle)	Empty (%)		
Late boot	0	106	14 a	201	100 c
	0.75	106	20 ab	188	96 c
	1.50	121	29 b	195	78 b
	3.00	106	54 c	196	43 a
	Mean	110	29	195	79
80% heading	0	87	17 ab	165	100 c
	0.75	117	9 a	200	100 c
	1.50	103	11 a	191	100 c
	3.00	104	15 ab	178	74 b
	Mean	103	13	184	94
Milk stage	0	92	12 a	202	100 c
	0.75	129	10 a	191	100 c
	1.50	116	9 a	181	100 c
	3.00	109	11 a	182	100 c
	Mean	113	11	188	100
Dough stage	0	124	14 a	194	100 c
	0.75	88	13 a	178	100 c
	1.50	101	9 a	187	100 c
	3.00	101	13 a	183	100 c
	Mean	104	12	185	100
	0	103	14	190	100
	0.75	110	13	189	99
	1.50	110	15	188	94
	3.00	105	23	185	79

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

Table 15. The effect of amidochlor used for seedhead suppression of red rice on rice cultivar main shoot development. Rice Research Station, Crowley, LA. 1985.^{1/}

Amidochlor application time ^{2/}	Amidochlor rate (lb/A)	Shoot dry weight (g)	Length					
			Stem	Stem internode				
				1	2	3	4	5
-----mm-----								
Late boot	0	1.94	900 de	10	87	184	225 e	394 de
	0.75	1.81	764 c	13	86	168	166 c	330 bcd
	1.50	2.53	639 b	6	59	146	120 b	308 bc
	3.00	2.19	495 a	4	62	141	92 a	196 a
	Mean	2.12	699	8	73 a	160 a	151	307
80% heading	0	1.71	985 e	26	113	222	226 e	398 de
	0.75	2.04	836 cd	4	58	164	218 de	392 de
	1.50	2.12	820 cd	7	59	174	202 d	378 de
	3.00	2.00	775 c	16	105	201	171 c	282 b
	Mean	1.96	854	13	84 a	190 b	204	362
Milk stage	0	1.94	951 e	33	112	216	225 e	365 cde
	0.75	2.59	954 e	23	108	207	226 e	390 de
	1.50	2.26	973 e	9	112	223	230 e	399 de
	3.00	2.13	955 e	26	120	206	228 e	374 cde
	Mean	2.25	959	22	113 b	213 c	227	383
Dough stage	0	1.89	952 e	16	89	208	234 e	404 e
	0.75	1.98	952 e	16	108	227	234 e	368 cde
	1.50	2.31	982 e	25	104	207	228 e	417 e
	3.00	2.05	990 e	26	118	215	262 f	368 cde
	Mean	2.06	969	21	105 b	214 c	240	389
	0	1.87	947	21	100	207	228	392
	0.75	2.10	876	14	90	191	211	370
	1.50	2.30	854	12	84	188	195	376
	3.00	2.08	804	18	101	191	188	305

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} Based on the growth stage of the rice cultivar.

late boot and 80% heading treatments. For the third internode, the late boot treatment resulted in a shorter length than the 80% heading treatment. For the fourth internode, length was dependent on rate of amidochlor for all rates at the late boot treatments, and for the 80% heading treatment internode length was rate dependent at the 0.75 and 1.5 lb/A rates. For the fifth internode, length was dependent on rate at the 0.75 and 1.5 lb/A rates for the late boot treatments, and internode length was affected by only the 3 lb/A rate at the 80% heading treatment.

These results show that stem and internode elongation when dramatically inhibited by amidochlor can interfere with panicle exertion and consequently panicle development and grain production. Lesser degrees of inhibition of the elongation processes do not affect grain production.

SUMMARY

Amidochlor was most effective applied at the 80% heading stage of growth based on the commercial variety. At this stage of growth and with a 2-week differential in growth between red rice and very early season maturing varieties, red rice was preboot to early boot which is a stage of growth sensitive to seedhead suppressants. Single applications of amidochlor were highly effective although secondary growth did result and produce some red rice seed. Multiple applications of amidochlor would provide more complete control of seed production. It is clear that applications of amidochlor before heading of the commercial rice are detrimental to commercial rice grain production. Amidochlor applied before booting in red rice can provide satisfactory red rice primary growth seedhead suppression at rates above 1.5 lb/A.

Amidochlor and Mefluidide Test

MATERIALS AND METHODS

A dry seedbed was prepared by discing and cultipacking the soil on May 21, 1985. The soil was fertilized with 8-24-24 with zinc (1.2%) at the rate of 300 lb/A. Plots (5 x 15 ft) were marked, flooded, and seeded with germinated seed of Labelle. On May 24, the plots were drained followed by flushing (flooding for 24 hours and draining) as needed based on soil moisture status. On June 6, propanil (1.5 lb ai/A) was applied for weed control. The next day 100 lb N/A as urea (45% N) was applied to the soil surface using a Gandy spreader. Plots were flooded to a permanent depth of 3 to 4 inches on June 6. On June 20, furadan (17 lb/A) was applied for water weevil control. On July 26, Labelle was 90% headed and the majority of red rice was preboot. Mefluidide treatments were imposed at this time. Mefluidide treatments included 0.25 lb/A (two treatments), 0.1875 lb/A, and 0.125 lb/A plus surfactant (1%). On July 30, Labelle was 100% headed and the amidochlor treatment imposed. Plots receiving amidochlor (1 lb/A) were isolated with metal flashing. Three weeks after treatment secondary growth was appearing. On August 16, all but one of the mefluidide treatments was reapplied at the same rate as the initial application. One of the 0.25 lb/A treatments was not reapplied in order to determine the difference between a single and double application of mefluidide. On August 22, a second application of amidochlor (1 lb/A) was made. On September 5, the experiment was terminated. Three red rice plants were removed from each plot and evaluated for seedhead suppression. A

6 ft² area was hand harvested from the center of each plot for grain moisture and yield determination. The experimental design was a randomized complete block with three replications.

RESULTS AND DISCUSSION

The effects of amidochlor and mefluidide on red rice seedhead suppression are presented in Table 16. Primary and secondary growth were evaluated for panicle suppression. Panicle suppression of primary growth was equally high for all seedhead suppressant treatments. Stems with primary growth panicles totally suppressed ranged from 89 to 100% for the seedhead suppressant treatments. There were no partially suppressed panicles and stems with no panicle suppression ranged from 0 to 11% for the seedhead suppressant treatments. In the untreated check, stems with no panicle suppression averaged 96%. Secondary growth was higher in the seedhead suppressant treatments than in the untreated check. Of the seedhead suppressant treatments, amidochlor and a single application of mefluidide (0.25 lb/A) had the highest secondary growth. Total panicle suppression of secondary growth panicles although variable was not significantly different between treatments. Partial panicle suppression was lowest for the single application of mefluidide (0.25 lb/A) and no panicle suppression of secondary growth was highest with the same mefluidide treatment.

SUMMARY

Amidochlor and mefluidide were equally effective as seedhead suppressants for primary growth in red rice. Differences noted on secondary growth which develops in response to the application of seedhead suppressants indicate amidochlor and mefluidide have similar activities when double applications are used. No differences in grain moisture or yield occurred between treatments. These results are not presented.

Fenoxaprop-ethyl Test

MATERIALS AND METHODS

A dry seedbed was prepared and fertilized with 8-24-24 with zinc (1.2%) at the rate of 300 lb/A. On May 3, 1985, plots (5 x 10 ft) were flooded and seeded with germinated seed of Labelle at the rate of 135 lb/A. Plots were drained and flushed periodically to promote seedling development. On May 20, the stage of growth of Labelle was 2- to 3-leaf and propanil (3 lb ai/A) was applied to the experiment for general weed control. At first tiller of Labelle (May 29) the first treatment of fenoxaprop-ethyl (0.15 lb/A) was applied. On May 30, plots were topdressed with nitrogen (urea) at the rate of 220 lb/A. Plots were flooded to a 1- to 2-inch depth on June 3 and on June 12 the stage of growth of Labelle was late tiller. At that time the second fenoxaprop-ethyl treatment was applied. On June 20, furadan (17 lb/A) was applied to the experimental area for water weevil control. On June 25, the stage of growth of Labelle ranged from second internode to panicle differentiation and the third treatment of fenoxaprop-ethyl was applied 2 days later. On July 16, the stage of growth of Labelle was late boot to early heading and the stage of growth of red rice was preboot to early boot. The fourth treatment of fenoxaprop-ethyl was applied. Plots were drained on August 14 and hand harvested on August 28. Data were collected from 2 x 3 ft areas in the center of each plot. Red rice stand was documented and a subjective evaluation of red rice plant development

Table 16. A comparison of amidochlor and mefluidide used for seedhead suppression of red rice on red rice primary and secondary growth seedhead suppression. Rice Research Station, Crowley, LA. 1985.^{1/}

Treatment ^{2/}	Primary growth ^{3/} panicle suppression			Secondary ^{4/} growth %	Secondary growth ^{3/} panicle suppression		
	Total	Partial	None		Total	Partial	None
1	0 a	4	96 b	0	0	0 a	0 a
2	100 b	0	0 a	134 c	37	59 bc	4 a
3	89 b	0	11 a	131 c	24	17 ab	59 b
4	97 b	0	3 a	97 b	11	59 bc	30 ab
5	89 b	0	11 a	90 b	28	53 bc	9 a
6	100 b	0	0 a	100 b	11	86 c	3 a

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

^{2/} 1 = untreated check.
 2 = amidochlor, 1 lb/A, 2 applications;
 3 = mefluidide, 0.25 lb/A, 1 application;
 4 = mefluidide, 0.25 lb/A, 2 applications;
 5 = mefluidide, 0.125 lb/A with surfactant, 2 applications;
 6 = mefluidide, 0.1875 lb/A, 2 applications.

^{3/} Expressed as percentage of stems with panicles not, partially or totally suppressed.

^{4/} 100 = one secondary stem per primary stem.

was made. Red rice plants were classified as either normal or abnormal depending on appearance. Normal red rice plants were 120 to 140 cm in height and greyish brown in color and had 3 to 4 fully developed tillers and fully exserted, mature panicles with seed shattering. Abnormal red rice plants were less than 75 cm in height and green in color and had 1 to 2 tillers and no or partially exserted panicles with no or little seed formation. Labelle was evaluated for plant height and grain yield. The experiment was designed as a randomized complete block with three replications.

RESULTS AND DISCUSSION

Although there were several fenoxaprop-ethyl treatments which affected red rice, the most striking results occurred with treatment 3 (Table 17). Treatment 3 involved the application of fenoxaprop-ethyl during the late tillering stage of growth of the commercial variety. Data collected at harvest maturity of Labelle show there were as many red rice plants on the average in treatment 3 as in the other treatments but there was one dramatic difference. All of the red rice in the plots which received treatment 3 exhibited abnormal growth and development. These abnormal red rice plants were smaller than normal. Visually, they appeared to be about 12 to 14 inches shorter in stature and leaf length was several inches shorter in length in comparison to normally developed red rice plants. In addition, the maturity of these abnormally developed red rice plants was later in comparison to normally developed red rice plants. When the commercial variety was mature, abnormal red rice plants were at the first or early heading stages of growth, and consequently, produced no seed. At the same time, normally developed red rice plants in other treatments were maturing and produced seed.

The commercial variety Labelle was measured for plant height and grain yield at maturity. All applications of fenoxaprop-ethyl reduced plant height and did not affect grain yield (Table 17). The reduction in plant height can be beneficial. Shorter plants are less susceptible to lodging. All plots lodged due to high winds from a hurricane.

SUMMARY

In summary, the application of fenoxaprop-ethyl during the late tiller stage of growth of Labelle had a growth regulator effect on red rice. There was no effect on the level of red rice infestation, but there was an affect on the growth and development of the red rice. The effect was such that the red rice was rendered uncompetitive and unproductive. Although this is not the classic type of weed control, it would be a very acceptable type of control for red rice in commercial rice production. Labelle growth and development were also affected by fenoxaprop-ethyl. Plant height was reduced with no affect on grain yield

III. RICE BIOMASS ALTERATION FOR CRAWFISH PRODUCTION

Nitrogen Fertility, Mefluidide, and Gibberellin Test

MATERIALS AND METHODS

In 1985 following dry seedbed preparation, plots (7 x 24 ft) were drill seeded with Labelle rice and fertilized through separate placement with 8-24-24

Table 17. Effects of time of application of fenoxaprop-ethyl on the growth and development of red rice (Oryza sativa L.) and commercial rice (Oryza sativa var. Labelle). Rice Research Station, Crowley, LA. 1985.

Red rice								
Trt	Plant development			Panicle development		Labelle		
	Normal	Abnormal	Total	Normal	Normal			
	(plants/6ft ²)	(plants/6ft ²)	(plants/6ft ²)	(% of total)	(panicles/plant)			
2/						Yield (g/6ft ²)		
1	8a	7ab	15a	49ab	23a	2.4ab	107a	90a
2	6ab	3a	9a	32ab	23a	3.6a	93b	115a
3	0c	11b	11a	100d	0a	0.0b	90bc	105a
4	2bc	8ab	10a	82cd	7a	1.8ab	88bc	112a
5	3bc	6ab	9a	72bc	7a	2.4ab	86c	98a

1/ Means within a column followed by the same letter are not significantly different with $\alpha = .05$ using the Duncan's Multiple Range procedure.

2/ Treatment 1 - Propanil (3 lb ai/A) at the 2-3 leaf stage and early tillering.

Treatment 2 - Propanil (3 lb ai/A) at the 2-3 leaf stage and whip (0.15 lb ai/A) at early tillering.

Treatment 3 - Propanil (3 lb ai/A) at the 2-3 leaf stage and whip (0.15 lb ai/A) at 2 weeks following early tillering (late tillering).

Treatment 4 - Propanil (3 lb ai/A) at the 2-3 leaf stage and whip (0.15 lb ai/A) at panicle differentiation (2mm panicle).

Treatment 5 - Propanil (3 lb ai/A) at the 2-3 leaf stage and whip (0.15 lb ai/A) at late booting.

at the rate of 300 lb/A. There was stand failure and the experiment was reseeded using water seeding. Waterfowl predation resulted in stand failure again. The experiment was drained and allowed to dry. Plots were reseeded using a Tye drill in an undisturbed seedbed on July 26. The variety of rice was Mars and the rate of seeding was 100 lb/A. Emergence was first observed on July 31. Propanil was applied to the experimental area for weed control on August 6 and 19 and September 6 at rates of 1, 2, and 3 lb ai/A, respectively. On August 27, the stage of growth of the rice was late tiller and gibberellin (6.4 g/A) was applied. Applications of gibberellin were also made on September 16 and October 17. On September 12, nitrogen topdressings of 24 and 48 lb/A were made. On October 2, the Mars rice stage of growth was prebooting (2-inch panicle) and mefluidide (0.25 lb/A) was applied. On October 28, a 3 x 5 ft area was harvested for biomass determination and flooded. Fresh and dry weights were measured. Dry weights were obtained after drying for 48 hours at 150°F. Plots were flooded and three additional samples were taken at 6-week intervals following flooding and biomass estimated.

Experimental design was a randomized complete block with three replications. The data were analyzed as split plot in time with a factorial arrangement of the nitrogen, mefluidide, and gibberellin treatments. Significant treatment effects were determined using the Duncan's multiple range test.

RESULTS AND DISCUSSION

Soil nitrogen fertility, mefluidide, and gibberellin affected rice biomass production (Tables 18-20). Nitrogen fertility increased biomass. At the time of flooding rice, fresh and dry weights were higher at the 48 and 72 lb/A rates of nitrogen compared to the 24 lb/A rate. Six weeks after flooding rice biomass was significantly higher for the 72 lb/A rate than for the 24 and 48 lb/A rates. The 24 and 48 lb/A rates were not significantly different. At 12 and 18 weeks after flooding, there was no difference in biomass among nitrogen treatments. Mefluidide reduced biomass production and gibberellin increased biomass production at the time of flooding. The effects were transient and significant effects of mefluidide and gibberellin were not noted at any of the other sampling times.

The inability of rice biomass production to respond consistently over time in a crawfish production system to nitrogen fertility and plant growth regulators may be related to type of plant growth most affected by the treatments. The timing of the treatments occurred after tiller production was complete and thus may not have had a significant affect on stem number. The primary effect of the treatments may have been on leaf growth. Observations of the plots showed that leaves degrade much faster than stems. This would explain the temporary effects of nitrogen fertility and plant growth regulators on biomass production.

SUMMARY

Nitrogen fertilizer and gibberellin stimulated biomass production and mefluidide reduced biomass production. The effects were transient and lasted for 12 weeks or less after flooding for crawfish production.

Table 18. The response of rice biomass to nitrogen fertility over time in a simulated crawfish production system. Rice Research Station, Crowley, LA. 1985.^{1/}

Time after flooding (weeks)	Nitrogen rate (lb/A)	Fresh weight (g)	Dry weight (g)
0	24	492 f	190 e
	48	614 g	234 f
	72	643 g	248 f
6	24	126 cd	33 abc
	48	173 de	49 cd
	72	216 e	57 d
12	24	80 abc	29 ab
	48	90 bc	32 abc
	72	86 abc	38 bc
18	24	38 ab	17 a
	48	35 a	17 a
	72	50 ab	22 ab

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

Table 19. The response of rice biomass to mefluidide over time in a simulated crawfish production system. Rice Research Station, Crowley, LA. 1985.^{1/}

Time after flooding (weeks)	Mefluidide rate (lb/A)	Fresh weight (g)	Dry weight (g)
0	0	626 e	240 e
	0.25	541 d	208 d
6	0	179 c	48 c
	0.25	165 c	44 c
12	0	93 b	36 bc
	0.25	78 ab	30 ab
18	0	44 a	19 a
	0.25	38 a	18 a

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

Table 20. The response of rice biomass to gibberellin over time in a simulated crawfish production system. Rice Research Station, Crowley, LA. 1985.^{1/}

Time after flooding (weeks)	Gibberellin rate (lb/A)	Fresh weight (g)	Dry weight (g)
0	0	544 d	210 e
	6.4	623 e	238 f
6	0	187 c	48 d
	6.4	157 c	45 cd
12	0	85 b	32 bc
	6.4	86 b	34 bc
18	0	37 a	16 a
	6.4	44 a	21 ab

^{1/} Means within a column followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

CONCLUSIONS

Plant growth regulators can reduce lodging in commercial rice and minimize seed production of red rice. Modifications in stem development by plant growth regulators are responsible. Plant growth regulators applied during the vegetative stages of growth reduce internode elongation during the early stages of growth and plant growth regulators applied during the reproductive stages of growth reduce internode elongation associated with panicle exertion. The first effect reduces plant height without directly affecting grain production. Chemicals such as XE-1019 and mefluidide have this effect. The second effect reduces seed production since rice does not pollinate well unless the panicle is fully exerted.

Regarding the second effect in rice production, the differential in maturities between very early season commercial varieties and red rice can be used in conjunction with PGRs for seedhead suppression to minimize weed seed production. For example, mefluidide applied at the late boot stage of growth of Labelle and amidochlor applied during heading of Labelle can effectively limit the production of red rice seed without affecting grain production of Labelle. In addition, fenoxaprop-ethyl applied during late tillering of Labelle can significantly delay the growth and development of red rice while having minimal impact on the commercial variety. This can provide the commercial variety with a competitive edge and result in abnormal, unproductive red rice.

Rice growth and development in a crawfish production system is influenced independently by nitrogen fertility and plant growth regulators. The effects of these inputs are transient and additional information regarding the specific effects of nitrogen fertility and plant growth regulators on rice biomass in a crawfish production system can help better to determine the feasibility of these inputs.

CULTURAL PRACTICES FOR RED RICE SUPPRESSION

(A Progress Report)

Richard Dunand, John Baker, Russell Dilly, Jr., and Greg Meche

INTRODUCTION

Red rice (Oryza sativa L.) is a noxious weed in commercial rice production. The presence of red rice seed in a sample of harvested grain can affect the grade and quality of the sample. Both grade and quality are primary factors in the determination of the value of rice. Consequently, red rice can affect the price of rice significantly.

The development of cost effective practices to minimize red rice while maximizing commercial rice production are essential. The use of cultural practices to control red rice offers a solution. Cultural practices involve the use of facilities already available to the farmer, and would not require the additional outlay of capital associated with the purchase of equipment, chemicals, etc. In that vain cultural management practices need to be investigated to determine their effects on red and commercial rice production.

The sensitivity of rice to environmental factors during germination is established and indicates that temperature and oxygen are important during germination. Also after emergence the growth and development of commercial and red rice is affected by plant population. In the field, temperature and oxygen during germination can be affected by date of planting and management of irrigation water, and plant population can be affected by rate of seeding. Consequently, the effects of such cultural practices as date of planting, management of irrigation water and rate of seeding of commercial rice on red and commercial rice were studied.

MATERIALS AND METHODS

March Date of Seeding

An area naturally infested with red rice was selected, and on March 19, 1985 a dry seedbed was prepared. Preplant fertilizer was applied at the rate of 150-70-70 on the brief and no drainage treatments and at the rate of 30-70-70 on the prolonged drainage treatment. All plots were isolated by earthen levees, flooded to a depth of 1 to 2 inches and water seeded with germinated seed of Mars. Two rates of seeding were 135 and 202 lb/A (dry seed basis). Six days after seeding the brief and prolonged drainage treatments were drained. The no drainage treatment remained flooded until draining before harvest. After the seedlings established a shallow root system, the brief drainage treatment was flooded to a depth of 1 to 2 inches. The prolonged drainage treatments were flushed periodically, topdressed with urea at the rate of 260 lb/A and then flooded to a depth of 3 to 4 inches. Water depth was increased gradually as the rice grew in the brief and no drainage treatments

until a depth of 3 to 4 inches. Within 3 weeks after establishing the final flood, furadan was applied for water weevil control. All treatments were drained 2 weeks prior to harvest maturity and samples were collected to determine the effects of the cultural practices on plant population. All data were collected from two square foot areas as previously described (1).

April Date of Planting

In an area adjacent to the March date of planting experiment, a second experiment identical to the first experiment with the exception of date of planting was conducted. A dry seedbed was prepared on April 9, 1985. The plots were fertilized, isolated by earthen levees, and managed as previously described. Data collection was the same as the March date of planting.

The experimental design was a split-plot. Date of planting was assigned to main plots. Rate of seeding and water management practices were assigned to subplots in a factorial arrangement. The treatments assigned to subplots were replicated four times in a randomized complete block design.

RESULTS AND DISCUSSION

The effects of planting date, seeding rate, and water management on red rice and Mars rice plant stand are presented in Table 1. Both seedling stands and mature plant stands were affected by cultural management practices.

In the seedling stage, red rice stands were affected primarily by planting date and water management. For the March planting date, there was no effect of water management on red rice seedling stands. For the April planting date, red rice seedling stands were lowest with the no drainage system, intermediate with the brief drainage system, and highest with the prolonged drainage system. With the exception of the prolonged drainage system, red rice seedling stands were lower for the March planting date compared to the April planting date. Seedling stands of Mars rice were affected differently. Seeding rate and water management system had the greatest effects on Mars seedling stands. At the low seeding rate (135 lb/A), water management system had no effect on Mars seedling stand. At the high seeding rate (202 lb/A), however, Mars rice seedling stands were equally low with the no and brief drainage systems compared to the prolonged drainage system. Also, there was no effect of planting date on Mars seedling stands.

At maturity, stands of red rice were generally about the same as in the seedling stage but Mars rice stands were slightly lower than in the seedling stage in many cases. Also the effects of planting date, Mars seeding rate, and water management system on mature rice stands were different from their effects in the seedling stage. Mature red rice stands were affected by planting date, Mars seeding rate, and water management system together. For the March planting date, the effects of water management system on mature red rice stands were similar at both Mars seeding rates. For the April planting date, water management systems affected mature red rice stands differently depending on Mars rate of seeding. At the low Mars seeding rate, mature red rice stands were equally low with the no and brief drainage systems compared to the prolonged drainage system. At the high Mars seeding rate, mature red rice stands were equally high with the brief and prolonged drainage systems compared to the no drainage system. Mature Mars rice stands were affected by planting date and Mars

seeding rate. Water management system had no effect on mature Mars rice stands. For the March planting date, mature Mars stands were higher at the higher Mars rice seeding rate. For the April planting date, mature Mars rice stands were not affected by Mars rice seeding rate.

Planting date, commercial rice seeding rate, and water management system affect red rice and Mars rice stands directly which results in indirect effects on competition within and between the two rice types. The cooler weather generally associated with a March planting date compared to an April planting date restricts red rice germination and growth and minimizes the competition of red rice with commercial rice. The effects of the cooler environment can be minimal on the commercial rice since the water acts as a buffer against environmental changes. This keeps the young commercial rice plant in a relative constant environment after seeding. Under the influence of a warmer environment (April planting date), red rice germinates and grows well establishing plant populations which can be competitive with the commercial rice. Maintaining a constantly flooded soil environment produces unsatisfactory conditions for rice to germinate and emerge through soil minimizing red rice stands. Commercial rice seeded onto the soil surface and not covered with soil can produce satisfactory stands in a flooded environment. Under slightly adverse environments, such as the cooler environment associated with a March planting date, high seeding rates of commercial rice can provide higher commercial rice stands, especially when red rice competition is reduced by the same environment.

CONCLUSIONS

Cultural practices associated with planting date, commercial rice seeding rate, and water management system can reduce red rice stands while allowing adequate stands of commercial rice. Best cultural management can be obtained by planting in late March at commercial rice seeding rates approximating 202 lb/A (dry seed basis) and water seeding into a flooded field with a permanent flood depth of 3 to 4 inches which is maintained until drainage for harvest.

LITERATURE CITED

1. Sonnier, Earl A., John B. Baker and Lawrence M. White III. 1982. Red rice studies: Cultural management experiment. In: Ann. Prof. Rpt., Rice Res. Stn., La. Agri. Exp. Stn., L.S.U. Agricultural Center, 74:235-241.

Table 1. The effect of planting date, seeding rate, and water management on red rice and rice cultivar stands. Rice Research Station, Crowley, LA. 1985.^{1/}

Planting date	Seeding rate (lb/A)	Water management system	Seedling stand		Mature plant stand	
			Red rice	Mars rice	Red rice	Mars rice
			-----plants/ft ² -----			
March	135	No drainage	<1 a	16 a	<1 a	15 a
		Brief drainage	1 a	29 ab	<1 a	14 a
		Prolonged drainage	5 a	25 ab	5 bcd	14 a
	202	No drainage	<1 a	30 b	<1 ab	20 b
		Brief drainage	2 a	28 ab	1 abc	19 b
		Prolonged drainage	4 a	40 c	5 bcd	25 b
April	135	No drainage	2 a	24 a	3 a-d	11 a
		Brief drainage	6 b	25 ab	7 d	11 a
		Prolonged drainage	38 c	25 ab	24 f	12 a
	202	No drainage	3 a	32 b	3 a-d	18 a
		Brief drainage	19 b	30 ab	12 e	8 a
		Prolonged drainage	31 c	60 c	16 e	11 a

^{1/} Means within columns followed by the same letter are not significantly different (P = 0.05) according to the Duncan's multiple range test.

RICE WEED CONTROL STUDIES^{1/}

(A Progress Report)

John B. Baker and James W. Shrefler

INTRODUCTION

Weed control must be an essential part of the rice production process if high yielding, high quality rice is to be produced. The objective of this research is to evaluate new chemicals to determine their potential as tools that can be used in conjunction with other practices in carrying out an economically sound weed control program.

MATERIALS AND METHODS

These studies were conducted in fields which were left fallow in 1984 in order to reinfest the soil with weed seed.

Normal seedbed preparation began in early spring, with final seedbed preparation just before planting. During the final seedbed preparation 375 lb/A of 20-10-10 was worked into the soil.

In water-seeded tests, the plots were staked and any preplant treatments applied prior to flooding for seeding. Unless specified otherwise, presprouted Mars was sown with a hand-carried centrifugal seeder at a seeding rate equivalent to 125 lb/A of dry seed. Following seeding, the flood water was removed to permit seedling establishment. The permanent flood was applied at the time designated in the individual experiment and is indicated as a footnote in the tables.

In the drill-seeded test, Mars was planted with an 11-runner drill with 7-in row spacings at a seeding rate of 110 lb/A. An 18 in unplanted strip was left between each drill-strip to serve as a buffer zone to minimize spray drift between plots.

Sprays were applied at 25 G/A with a CO₂-pressured sprayer equipped with a 4-nozzel, 80-in wide boom with flat-fan tips² delivering 480 ml/min with a tank pressure of about 32 psi. A ground speed of 2.5 mph was assured by using a portable metronome to pace the applicator.

Granular formulations were applied by distributing the appropriate weight of the formulated herbicide as uniformly as possible over the plot area. On small plots (ca. 5 sq ft) the material is sprinkled from a coin envelop, but on larger plots a small, centrifugal spreader was used. Postflood treatments were

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

applied to areas enclosed by earthen levees or aluminum cylinders to minimize movement of the materials from the treated area.

In the case of preplant-incorporated treatments, incorporation was carried out using a rotary tiller.

All tests had a randomized complete block design with four replications. Visual ratings of weed control and crop tolerance were made once or twice during the season. The weed control rating scale used was: 1 - no control to 5 - excellent control. The crop tolerance rating scale used was: 1 - no tolerance to 5 - excellent tolerance. Yield was estimated by one of two methods - a sample area, 3-ft by 6-ft in water-seeded fields or 5 drill rows by 6-ft in drill-seeded tests, was hand cut, the rice threshed using a nursery thresher, and the grain weight determined or an area 2.33 ft by 62.25 ft was harvested with a small combine and the grain weight determined.

RESULTS AND DISCUSSION

Information on treatments and other details of these tests are presented in the tables.

Drill-seeded herbicide comparison test. Data on this test are presented in Table 1. Weeds were quite large at the time of the postemergence treatments (23 days after seeding), and although propanil performance on junglerice was less than satisfactory, control of signalgrass, sprangletop and hemp sesbania was quite good. SC-0254 gave excellent control of hemp sesbania, but was totally inadequate on grasses. When tank-mixed with propanil, it was only slightly better than propanil alone. BAS-514 gave excellent control of hemp sesbania and junglerice although it was a little weak on junglerice at the 0.25 lb ai/A rate. Control of signalgrass and sprangletop was rated only fair to good, although the signalgrass probably died later in the season. When applied a week later control of these latter two species seemed to be slightly better. All of the BAS-514 treatments yielded as well as the propanil check.

Water-seeded herbicide comparison test. Data on this test are presented in Table 2. Although the weeds were larger than optimum for propanil, excellent control of all weeds except junglerice was obtained, and control of it was good. SC-0254 gave excellent control of the broadleaf weeds and rice flatsedge at the higher rates, but was totally inadequate on the grassy weeds. When tank-mixed with propanil it gave better junglerice control than propanil alone. BAS-514 applied 14 days after seeding was most active on hemp sesbania, giving excellent control at all rates. It was also very effective on junglerice. Control of signalgrass, rice flatsedge and jointvetch was very rate dependent, but excellent control was observed at the highest rates. Sprangletop control was poor at all rates. Although the rating on control of jointvetch at the intermediate rate indicated good control, there were enough plants left to produce an unacceptable amount of jointvetch seed in the harvested rice. Treatments applied five days later gave essentially the same results, however the control of jointvetch was better giving a cleaner sample of rice. HOE-33171 was applied at two times followed by a midseason application of 2,4-D for broadleaf control. Since ratings were made before the 2,4-D application, they reflect only the activity of HOE-33171. The yield data primarily reflect the effect of HOE-33171 on the rice since broadleaf weeds were removed with 2,4-D. Unacceptable levels of rice injury occurred at the

Table 1. Drill-seeded herbicide comparison test. Rice Research Station, Crowley, LA. 1985.^{1/}

Herbicide	Rate (lb ai/A)	Time of treatment ^{2/}	Rice Tolerance ^{3/} Ratings ^{3/}	Weed Control Rating ^{4/}			SE	Yield ^{5/} (100 lb/A)
				EC	BP	LP		
Untreated	-	-	5.0	1.0	1.0	1.0	1.0	4.9a
Propanil (3EC)	3	Post	4.75	2.75	4.5	4.75	5.0	48.2 c
SC-0245(4F)	1	Post	4.67	1.25	1.25	1.25	5.0	24.8 b
SC-0254	2	Post	5.0	1.25	1.25	4.0	5.0	12.4ab
SC-0254	4	Post	5.0	1.0	1.0	3.25	5.0	15.6ab
Propanil + SC-0254	3 + 2	Post	4.75	3.25	5.0	4.75	5.0	50.8 c
BAS-514 (50WP)	.25	Post	4.75	3.75	3.0	3.25	4.7	56.3 c
BAS-514	.375	Post	5.0	4.75	4.0	3.75	5.0	51.2 c
BAS-514	.5	Post	4.75	4.75	4.0	3.25	5.0	53.4 c
BAS-514	.75	Post	5.0	4.75	4.5	3.75	5.0	53.3 c
BAS-514	.375	Late Post	4.0	4.25	3.25	3.75	4.5	47.9 c
BAS-514	.5	Late Post	3.75	5.0	3.75	4.0	5.0	47.6 c
BAS-514	.75	Late Post	4.0	4.75	4.5	4.0	5.0	49.8 c
BAS-514	1.0	Late Post	4.5	5.0	5.0	4.5	5.0	48.6 c

^{1/} Seeded: 5/7/85. Emerged: 5/15/85. Flooded: 7/5/85.

^{2/} Treatments applied: Post - 5/30/85. Late Post - 6/7/85.

^{3/} Ratings taken 7/3/85. 1 - no tolerance to 5 - excellent tolerance.

^{4/} Ratings taken 7/3/85. 1 - no weed control to 5 - excellent weed control.

See Table 6 for weed identification.

^{5/} Harvested 9/25/85. Means followed by the same letter are not significantly different at the .05 probability level.

Table 2. Water-seeded herbicide comparison test. Rice Research Station, Crowley, LA. 1985^{1/}.

Herbicide ^{2/}	Rate (lb ai/A)	Time treatment ^{3/}	Rice tolerance rating ^{4/}	Weed Control Ratings ^{5/}				SE	CI	AV/I seed per 200 gm	Yield (100 lb/A) ^{6/}
				BP	EC	LP	AV/I				
Untreated	-	-	5.0	1.0	1.25	1.0	1.25	1.75	1.0	9.5	20.7 de
Propanil(3 EC)	3.0	Post	5.0	5.0	4.25	4.75	5.0	5.0	5.0	5.0	45.9a
SC-0254(4 F)	1.0	Post	5.0	2.0	3.0	1.5	3.5	4.75	5.0	266.0	36.1abc
SC-0254	2.0	Post	5.0	1.33	2.0	1.67	5.0	5.0	5.0	-	36.4 ^{7/}
SC-0254	4.0	Post	5.0	3.75	4.0	1.5	5.0	5.0	5.0	26.3	34.2abc
Propanil + SC-0254	3.0 + 2.0	Post	4.75	5.0	5.0	5.0	5.0	5.0	5.0	2.5	41.3ab
BAS-514 (50WP)	.25	Post	5.0	2.25	4.0	2.0	3.25	5.0	2.75	387.8	35.2abc
BAS-514	.375	Post	5.0	4.75	5.0	2.0	4.5	4.75	3.75	274.0	44.2a
BAS-514	.50	Post	5.0	5.0	4.75	1.75	4.5	5.0	3.67	132.3	37.9ab
BAS-514	.75	Post	4.0	5.0	5.0	2.5	5.0	5.0	5.0	-	40.1 ^{7/}
BAS-514	.375	Late Post	5.0	3.5	3.75	1.75	4.75	5.0	5.0	10.3	41.4ab
BAS-514	.50	Late Post	5.0	4.0	4.75	1.75	5.0	5.0	3.75	12.0	40.1ab
BAS-514	.75	Late Post	5.0	5.0	4.75	2.5	5.0	5.0	5.0	11.3	44.4a
BAS-514	1.0	Late Post	5.0	5.0	5.0	1.75	5.0	5.0	2.75	1.0	42.5ab
HOE-33171/2,4-D	.075/1.5	Post/Mid	4.5	5.0	5.0	3.5	1.5	1.5	1.5	-	32.9 ^{7/}
HOE-33171/2,4-D	.15/1.5	Post/Mid	3.0	5.0	5.0	5.0	1.0	1.0	1.0	7.8	21.8 de
HOE-33171/2,4-D	.3/1.5	Post/Mid	1.75	5.0	5.0	5.0	1.0	1.0	1.0	20.8	13.4 e
HOE-33171/2,4-D	.075/1.5	Late Post/Mid	4.25	3.5	2.75	3.25	2.0	2.25	1.5	3.0	31.2 bc
HOE-33171/2,4-D	.15/1.5	Late Post/Mid	2.75	5.0	4.75	5.0	1.0	1.0	1.25	2.3	25.5 cd
HOE-33171/2,4-D	.3/1.5	Late Post/Mid	2.25	5.0	5.0	5.0	1.0	1.0	1.0	2.5	19.4 de

^{1/} Seeded: 5/31/85. Drained: 6/1/85. Flushed: 6/6/85. Flooded: 6/20/85.

^{2/} Plots treated with HOE-33171 were treated with 2,4-D at midseason for broadleaf weed control.

^{3/} Post: postemergence treatments applied 6/14/85. Late Post: postemergence treatment applied 6/19/85. Mid: midseason treatments applied 7/24/85.

^{4/} Ratings taken 7/23/85: 1 - no tolerance to 5 - excellent tolerance.

^{5/} Ratings taken 7/23/85: 1 - no control to 5 - excellent control. See Table 6 for weed identification.

^{6/} Treatment means followed by the same letter are not significantly different at .05 probability level. CV=162

^{7/} Mean based on 2 or 3 observations and not included in analysis of variance.

higher rates at both times of application. Control of grassy weeds was excellent at the higher rates at both times of application. Other weeds were not controlled at any rate at either time of application. Yield were reduced significantly below the propanil check.

Granular post-flood herbicide comparison test. Data on this test are presented in Table 3. In this test a fairly early flood, although not early enough to be considered a "pinpoint" flood, gave fairly good control of most weeds, but ratings were made at harvest since there appeared to be some differences between plots. Jointvetch was controlled as well by the high rate of BAS-514 and thiobencarb as it was by the propanil check. Best control of purple ammania was provided by thiobencarb with the high rate of BAS-514 providing good control. The outstanding activity of BAS-514 on hemp sesbania is obvious. Both thiobencarb and propanil provided good control. Although no ratings are shown it was noted during the year that all plots except those treated with thiobencarb had ducksalad in the border areas. There were no significant differences between the yield means, although thiobencarb, which had the best overall weed control, was highest.

Water-seeded herbicide screening test. Data on this test are presented in Table 4. Sethoxydim seems to perform like HOE-33171. They are very active on grassy weeds, weak on broadleaf weeds, and injurious to Mars at rates needed to get grass control. BAS-514 gives excellent control of junglerice and hemp sesbania but is not as active on jointvetch. Thiobencarb is very active on junglerice but weak on hemp sesbania and jointvetch when used as a preplant surface application in water-seeded rice with a delayed flood. The tank mixture of a half rate of thiobencarb with a normal rate of propanil offered nothing over propanil alone. Both PPG-844 and PPG-1013 were very active on hemp sesbania. Activity on jointvetch was excellent with PPG-1013 and good with PPG-844. Neither was very active on junglerice. Since propanil alone gave excellent control of all weeds rated, improvement by tank mixes was not possible.

Post-flood granular herbicide screening test. Data on this test are presented in Table 5. Granular BAS-514 was very active on hemp sesbania but not as active on hemp sesbania or jointvetch as spray formulations. It seemed to be more active on signalgrass than the spray applications but no more active on sprangletop. SC-0254 used alone was generally weak at the rates tested but at the highest rate it performed well on hemp sesbania and jointvetch. When SC-0254 was used in combination with molinate broad spectrum weed control was slightly better than either used alone, with good control of all weeds at the high rate. SC-2957 was generally weak on all weeds, showing most activity on sprangletop. When SC-2957 was mixed with the low rate of SC-0254 only the control of hemp sesbania was improved. Thiobencarb applied at postflood was ineffective.

Information on the herbicides tested is provided in Table 7.

Table 3. Granular Herbicide Comparison Test. Rice Research Station, Crowley, LA. 1985.^{1/}

Herbicide ^{2/}	Rate (lb ai/A)	Yield ^{3/} (100 lb/A)	Weed Control Ratings ^{4/}		
			AV/I	AC	SE
BAS-514(1G)	.25	34.1	2.9	3.9	4.6
BAS-514	.375	30.3	2.9	3.1	5.0
BAS-514	.50	29.5	3.9	2.8	5.0
BAS-514	.75	31.5	4.5	4.4	5.0
Molinate(10G)	3.0	32.1	3.6	4.0	1.0
Thiobencarb(10G)	4.0	40.0	4.8	5.0	4.4
Propanil check	3.0	29.4	4.9	2.9	4.6
Untreated	-	29.3	3.8	3.9	2.8

^{1/} Seeded: 6/7/85. Drained: 6/7/85. Flooded: 6/17/85.

^{2/} Propanil applied: 6/12/85. Granular formulations applied: 6/20/85.
^{3/} CV=32%. No significant differences between the treatment yields as determined by analysis of variance.

^{4/} Ratings taken at harvest: 1 - no control to 5 - excellent control.
 See Table 6 for weed identification.

Table 4. Water-seeded screening. Rice Research Station, Crowley, LA. 1985.^{1/}

Herbicide	Rate (lb ai/A)	Time of treatment ^{1/}	Rice Tolerance Ratings ^{2/}	Weed Control Ratings ^{3/}		
				EC	SE	AV/I
BAS-514 (50WP)	.25	Post	4.75	3.88	5.0	3.5
BAS-514	.375	Post	4.68	4.88	5.0	4.0
BAS-514	.50	Post	4.75	4.88	4.88	4.63
BAS-514	.75	Post	4.25	4.0	4.13	4.13
HOE-33171 (IEC)	.075	Late Post	3.63	4.5	1.63	1.25
HOE-33171	.15	Late Post	2.88	4.88	1.63	1.13
HOE-33171	.30	Late Post	1.88	5.0	1.63	1.0
Sethoxydim (1.5EC)	.0375	Late Post	4.50	2.88	1.5	1.25
Sethoxydim	.075	Late Post	3.88	4.13	1.75	1.38
Sethoxydim	.15	Late Post	3.13	5.0	1.38	1.0
Thiobencarb(8EC)	2	PPS	4.5	5.0	1.75	1.25
Thiobencarb	4	PPS	4.38	5.0	2.13	1.13
Thiobencarb/ Thiobencarb+Propanil	2/2+3	PPS/Post	4.13	5.0	5.0	4.88
Thiobencarb+Propanil	2+3	Post	4.88	4.68	5.0	3.88
Propanil (3EC)	3	Post	4.5	4.75	5.0	5.0
Thiobencarb/PPG-844	4/.2	PPS/Post	4.13	5.0	5.0	4.13
Thiobencarb/PPG-1013	4/.03	PPS/Post	4.25	5.0	5.0	5.0
PPG-844 (2EC)	.2	Post	5.0	3.0	5.0	3.88
PPG-1013 (0.5EC)	.03	Post	4.88	1.13	5.0	4.88

^{1/} Seeded: 5/31/85. Flooded: 6/20/85. Treatments applied: PPS - 5/30/85; Post - 6/14/85;

Late Post - 6/19/85.

^{2/} Average of ratings taken on 7/9/85 and 9/5/85: 1 - no tolerance to 5 - excellent tolerance.

^{3/} Average of ratings taken on 7/9/85 and 9/5/85: 1 - no weed control to 5 - excellent weed control.

See Table 6 for weed identification.

Table 5. Water-seeded screening: Postflood, postemergence granular treatment. Rice Research Station, Crowley, LA. 1985.^{1/}

Herbicide	Rate (lb ai/A)	Rice Tolerance ^{3/} Rating ^{2/}	Weed Control Ratings ^{2/}			
			EC	BP	LP	SE
BAS-514(1G)	.25	4.8	1.4	2.4	3.5	5.0
BAS-514	.375	4.9	2.5	4.0	3.5	5.0
BAS-514	.50	5.0	2.3	4.0	3.0	5.0
BAS-514	.75	4.9	4.0	4.8	2.5	5.0
SC-0254(10G)	1	5.0	1.3	2.0	3.5	2.3
SC-0254	2	5.0	1.4	1.6	2.5	3.3
SC-0254	3	5.0	2.6	3.5	2.0	5.0
SC-2957(10G)	1	5.0	2.3	2.1	4.0	2.5
SC-2957	2	5.0	1.6	2.1	5.0	2.5
SC-2957	4	5.0	3.3	3.3	3.5	2.3
SC-0254 + SC-2957	1 + 1	5.0	1.4	2.0	2.5	2.5
SC-0254 + SC-2957	1 + 2	5.0	2.1	2.3	4.5	5.0
SC-0254 + SC-2957	1 + 4	5.0	2.6	3.1	5.0	4.3
SC-0254 + Molinate	1 + 3	5.0	4.0	2.5	5.0	2.5
SC-0254 + Molinate	2 + 3	5.0	3.0	2.8	4.5	5.0
SC-0254 + Molinate	3 + 3	4.9	4.1	4.1	5.0	4.0
Molinate(10G)	3	4.9	3.6	2.9	4.0	3.3
Molinate	4	4.9	4.4	3.8	5.0	3.5
Thiobencarb(10G)	3	5.0	2.1	2.1	3.0	4.0
Thiobencarb	4	5.0	2.0	1.3	4.0	2.5

^{1/} Seeded: 5/31/85. Flooded: 6/20/85. Treatments applied: 6/21/85.

^{2/} Average of ratings taken 7/23/85 and 9/5/85: 1 - no tolerance to 5 - excellent tolerance.

^{3/} Average of ratings taken 7/23/85 and 9/5/85: 1 - no tolerance to 5 - excellent weed control.

See Table 6 for weed identification.

Table 6. Weeds rated in herbicide tests conducted at the Rice Research Station, Crowley, LA. 1985.

Abbreviation used in tables	Common name	Scientific name
AC	purple ammannia	<u>Ammannia coccinea</u>
AV	northern jointvetch	<u>Aeschynomene virginica</u>
AI	Indian jointvetch	<u>Aeschynomene indica</u>
BP	broadleaf signalgrass	<u>Brachiaria platyphylla</u>
CI	rice flatsedge	<u>Cyperus iria</u>
LP	Amazon sprangletop	<u>Leptochloa panicoides</u>
SE	hemp sesbania	<u>Sesbania exaltata</u>

Table 7. Herbicides tested in studies at the Rice Research Station, Crowley, LA. 1985.

Name or code no. used in report	Chemical nature of active ingredient	Product name and manufacturer
BAS-514	not released at this time	BASF
2,4 - D	(2,4-dichlorophenoxy)acetic acid, diethanol amine salt	various
HOE-33171	ethyl 2-(4-(6-chloro-2-benzoxazolyloxy)-phenoxy) propanoate	Whip - Am. Hoechst
molinate	<u>S</u> -ethyl hexahydro-1H-azepine-carbothioate	Ordram - Stauffer
PPG-844	1'-(carboethoxy)ethyl 5-(2-chloro-4-(trifluoromethyl) phenoxy)-2-nitrobenzoate	Cobra- PPG Industries
PPG-1013	not released at this time	PPG Industries
propanil	3',4'-dichloropropionanilide	Stam - Rohm & Haas
SC-0254	not released at this time	Stauffer
SC-2957	not released at this time	Stauffer
sethoxydim	2-(1-(ethoxyimino)butyl)-5-(2-(ethylthio)propyl)- 3-hydroxy-2-cyclohexen-1-one	Poast - BASF
thiobencarb	<u>S</u> -(4-chlorobenzyl) <u>N,N</u> -diethylthiolcarbothioate	Bolero - Chevron

CHEMICAL CONTROL OF RED RICE IN RICE^{1/}

(A Progress Report)

John B. Baker, Richard T. Dunand, and James W. Shrefler

INTRODUCTION

Red rice (Oryza sativa) can cause reduced yield, reduced grade, and reduced milling quality if it is growing in rice. The extent of loss is primarily a function of the intensity of the red rice infestation. It is desirable, of course, to get complete control so that no red rice seed are produced to reinfest the soil. The objective of this research is to develop chemical control procedures which can be used in conjunction with other control procedures to reduce losses in yield and quality of the rice and also to minimize the red rice seed being returned to the soil to infest subsequent crops.

MATERIALS AND METHODS

Tests involving control of red rice in the rice crop were conducted in a field which had a natural infestation of red rice. Although the test area was in rice in 1984 and there was considerable red rice produced, the red rice infestation in 1985 turned out to be light and nonuniform. Test on the tolerance of cultivars to treatments which may be applied to control red rice were conducted in a red rice free area.

In water-seeded tests a good seedbed was prepared, levees constructed, preplant herbicide applied and the area flooded for seeding. When presprouted seed were sown, the flood water was removed to improve stand establishment and reflooded at the time specified in the experimental plan. When dry seed were planted the flood water was held for five days and then drained for five days before reflooding. To rule out variation due to water-management effects on fertilizer utilization, the plots were fertilized at a rate of 375 lb/A of 20-10-10 when all plots had been permanently flooded.

In the drill-seeded test a good seedbed was prepared, preplant herbicides applied and the rice planted with a 11-runner drill. Preemergence herbicides were applied 3 days after planting on a wet seedbed. The rice was flushed as needed to aid in stand establishment and flooded when the rice was in the 3 to 4 leaf stage. Fertilizer was applied one week after flooding at a rate of 375 lb/A or 20-10-10.

The drill-seeded red rice screening study had a randomized complete block split-plot design with four replications. The variety tolerance test had a

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

randomized complete block split-split-plot design with four replications. Other tests had simple randomized complete block designs with four replications. Quantitative data from all tests were subjected to analysis of variance.

Stand count data were taken in the method of application test by pulling all the rice plants from a 2 sq ft sample area, examining each plant to determine if red rice or cultivar, and counting. Panicle count data were collected at maturity by handcutting the rice in a 9 sq ft sample area and counting the red rice and cultivar panicles. The cultivar panicles in some tests were threshed to determine grain yield.

RESULTS AND DISCUSSION

Method of application test. Information on treatments and results are found in Table 1. As mentioned previously, the red rice infestation was light and nonuniform. This is shown in the very high coefficients of variation.

Since the red rice infestation was low and erratic the treatment effects were not striking. Treatments applied in the nondragged seedbed did not significantly reduce the red rice stand density nor the red rice panicle density when compared to the untreated nondragged seedbed even though some of these treatments had the lowest stand densities in the test. In the dragged seedbed only molinate as a postdragging treatment significantly reduced the red rice stand density, and none of the treatments reduced the panicle density. As a postflood treatment in the nondragged seedbed thiobencarb increased red rice seed production significantly. This is probably a reflection of the relatively poor control of red rice and the relatively good control of other weeds which competed with the red rice in the untreated nondragged check. In the dragged seedbed the postdragging application of molinate was the only treatment which significantly reduced red rice seed production compared to the dragged check. There were no significant treatment effects on Mars stand density or panicle density. Although there were significant differences between treatment yields, they did not occur between meaningful comparisons. Much of the yield increase in certain treatments is a reflection of general weed control rather than specifically red rice. The preplant surface (PPS) application of thiobencarb in a nondragged seedbed gave the cleanest plots with no weeds except a few red rice plants. The preplant incorporated (PPI) application of molinate and the preplant postflood application of thiobencarb in nondragged seedbeds controlled all weeds except for a few purple ammania plants and an occasional jointvetch plant.

Variety tolerance test. Results of this test are presented in Table 2. Stand establishment in plots treated with thiobencarb PPS or molinate PPI was not different from that in untreated plots. There were no variety by herbicide interactions indicating that no varieties were sensitive to the herbicides. The significant differences between varieties may be due to differences in seed lots due to factors other than their genetic makeup. Further tests are needed to verify this varietal difference. There was a 38% better stand established where presprouted seed were planted than where dry seed were sown. This difference needs to be investigated further.

Thiobencarb yield tests. Results of these tests are presented in Tables 3 and 4. Two tests were conducted on the effect of rate of thiobencarb. One was

Table 1. Effect of herbicide method of application on red rice and Mars. Rice Research Station, Crowley, LA. 1985^{1/}.

Herbicide	Rate (lb/ai/A)	Type of Seedbed	Type of Application ^{2/}	Red Rice			Mars	
				Plants/yd ²	Panicles/yd ²	Grains/yd ²	Plants/yd ²	Panicles/yd ²
								Yield (100 lb/A)
None	-	Not dragged	-	11.3ab	47.0ab	3148ab	174	155
Molinate (8EC)	4.0	"	PPI	3.4a	4.0a	262a	126	193
Molinate (10G)	4.0	"	PPPoF	3.4a	9.3a	631a	231	174
Thiobencarb (8EC)	4.0	"	PPS	3.4a	18.8ab	1934a	81	213
Thiobencarb (10G)	4.0	"	PPPoF	6.8a	93.0 b	8357 c	77	125
None	-	Dragged	-	27.0 b	83.0ab	6307 bc	110	78
Molinate (10G)	4.0	"	PD	6.8a	17.6ab	1266a	102	140
Thiobencarb (10G)	4.0	"	PD	12.4ab	60.0ab	4054ab	135	182
Thiobencarb (10G)	4.0	"	PD	18.0ab	79.0ab	6259 bc	63	128
				CV = 82% *	CV = 74% *	CV = 90% *	CV = 58% ns	CV = 36% ns
								CV = 35% *

1/ Means within a column which are followed by the same letter are not significantly different at .05 probability level. NS indicates no significant differences between means at the .05 probability level.

2/ PPI: Herbicide applied to seedbed surface and incorporated with a rotary tiller before flooding for seeding.
 PPoF: Granular herbicide spread over flooded plot prior to seeding.
 PPS: Granular herbicide spread over flooded plot before flooding for seeding.
 PD: Granular herbicide spread over flooded plot after dragging the seedbed but before seeding.
 PD: Granular herbicide spread over flooded plot prior to dragging the seedbed in preparation for seeding.

Table 2. Varietal response to preplant herbicides and method of water seeding. Percentage of sown seed developing into seedlings. Rice Research Station, Crowley, LA. 1985.^{1/}

Variety	Thiobencarb	Molinate	Untreated	Average ^{2/}
	PPS	PPI		
Dry Seed				
TX-46	55.5	52.5	53.5	53.8a
Pecos	52.0	52.0	51.5	51.8a
Tebonnet	38.5	45.0	39.0	40.8 b
Lemont	43.0	37.0	40.0	40.0 b
Starbonnet	43.0	39.5	35.0	39.2 bc
Labelle	40.0	32.0	40.0	37.3 bcd
Lebonnet	38.5	33.5	38.5	36.8 bcd
Toro-2	37.0	40.0	30.5	35.8 cde
Bond	37.0	33.0	33.5	34.5 de
Skybonnet	27.0	40.0	35.0	34.0 de
Newbonnet	32.0	29.0	36.0	32.3 e
Average ^{3/}	40.3	39.4	39.3	39.7
Presprouted Seed				
TX-46	76.5	63.5	58.0	66.0a
Pecos	63.5	54.5	61.5	59.8 b
Tebonnet	52.5	45.5	67.0	55.0 bc
Lemont	60.0	51.0	64.0	58.3 bc
Starbonnet	51.0	47.5	50.5	49.7 de
Labelle	50.0	51.0	47.5	49.5 de
Lebonnet	63.5	58.0	60.0	60.5 b
Toro-2	53.5	55.0	52.0	53.5 cd
Bond	53.0	48.0	51.5	50.8 de
Skybonnet	49.0	41.5	47.0	45.8 e
Newbonnet	56.0	48.5	54.5	53.0 cd
Average ^{3/}	57.1	51.3	55.8	54.7

^{1/} Seeded 6/7/85. Thiobencarb applied PPS at 4 lb ai/A 6/6/85. Molinate applied PPI at 4 lb ai/A 6/6/85.

^{2/} Varietal means within each seeding method and within a column followed by the same letter are not significantly different at .05 probability level. Dry seed CV = 18.4%. Presprouted seed CV = 18.3%.

^{3/} Stands obtained with dry seed significantly lower than those obtained with presprouted seed at the .05 probability level.

Table 3. Effect of rate of thiobencarb on red rice and Mars when applied as a preplant, surface treatment in water-seeded rice. Rice Research Station, Crowley, LA. 1985.

Herbicide	Rate (lb ai/A)	Red rice		Mars	
		Panicles/yd ²	Florets/yd ²	Panicles/yd ²	Yield (100 lb/A)
thiobencarb	2	12.5	843	192	44.5
thiobencarb	4	11.5	1087	202	46.1
thiobencarb	6	8.3	911	199	49.2
thiobencarb	8	9.0	261	188	45.0
molinate ^{1/}	4	2.0	133	222	52.0
untreated	-	13.0	1022	210	45.7
		CV=112% NS	CV=102% NS	CV=12% NS	CV=14% NS

^{1/} Preplant incorporated, rather than surface treatment.

Table 4. Effect of preplant thiobencarb rate on yield. Rice Research Station, Crowley, LA.^{1/}

Herbicide	Rate (lb ai/A)	Time of Treatment ^{2/}	Yield ^{3/} (100 lb/A)
Thiobencarb	2	PPS	55.1a
Thiobencarb	4	PPS	36.9ab
Thiobencarb	6	PPS	42.4ab
Thiobencarb	8	PPS	32.1ab
Molinate	4	PPI	41.5ab
Untreated	-	-	10.2 b

^{1/} Seeded: 5/8/85. Drained: 5/8/85. Flooded: 5/14/85.

^{2/} PPS - preplant-surface treatment. Applied 5/7/85.

^{3/} PPI - preplant-incorporated treatment. Applied 5/7/85.

^{3/} Treatment means followed by the same letter are not significantly different at the .05 probability level. CV = 52%.

in a red rice infested area and the other was in an area without red rice. In neither case was there a significant difference between Mars yield at various rates of thiobencarb. The red rice infestation was low and erratic and no significant differences were detected in red rice panicle or floret production.

Drill-seeded herbicide screening for red rice control. Results of this test are presented in Table 5. Molinate treated plots had a significantly higher Mars panicle density than where molinate was not used. SC-0254 had no significant effect on Mars panicle density although there was an apparent trend towards higher panicle densities with higher rates of SC-0254. The effect of the herbicides on red rice panicle density was stimulated by SC-0254 in the absence of molinate but inhibited by SC-0254 in the presence of molinate.

Table 5. Drill-seeded herbicide screening for red rice control. Rice Research Station, Crowley, LA. 1985.^{1/}

Preplant treatment ^{2/}	Preemergence treatment ^{3/}	Panicle density ^{4/} (panicles / 9 sq ft)	
		Mars	Red rice
Molinate (8EC) - 3 lb ai/A	SC-0254 - 1 lb ai/A	134.0	67.3
Molinate - 3 lb ai/A	SC-0254 - 2 lb ai/A	153.3	42.5
Molinate - 3 lb ai/A	SC-0254 - 4 lb ai/A	180.3	32.5
Molinate - 3 lb ai/A	-	146.5	75.0
-	SC-0254 - 1 lb ai/A	130.8	139.8
-	SC-0254 - 2 lb ai/A	133.3	142.5
-	SC-0254 - 4 lb ai/A	149.8	89.3
-	-	95.3	77.0

^{1/} Mars drill-seeded at 110 lb/A on May 20. Flooded on June 10 and fertilized on June 17.

^{2/} Preplant incorporated molinate on May 20.

^{3/} Preemergence treatments applied May 23. Soil wet from rain on May 21.

^{4/} Mars panicle density significantly higher in molinate treated plots, but SC-0254 effects were not significant. Red rice panicle density lower in molinate treated plots. There was a significant interaction between the preemergence SC-0254 rates and the preplant molinate treatments.

RICE INSECT CONTROL STUDIES

RICE WATER WEEVIL CONTROL WITH ALSYSTIN: EFFECT OF APPLICATION TIMING

(A Progress Report)

J.F. Robinson, C.M. Smith, G.B. Trahan, and R.J. Michot

INTRODUCTION

Alsystin is an insect growth regulator that inhibits chitin synthesis. Previous tests, 1981-1984, have shown that alsystin applied as a postflood spray gives excellent rice water weevil control. Since alsystin controls rice water weevil primarily by reducing egg hatch and not by larval mortality, application timing is critical. The objective of this research was to evaluate the effects of four application timings of alsystin on rice water weevil control.

MATERIALS AND METHODS

The rice variety 'Mars' was drill-seeded on May 31, 1985 in plots 20-ft (length) x 4-ft (width). Each plot was surrounded by a levee to prevent insecticide movement in the flood water across treatments. Propanil (4 lb ai/A) was applied by plane on June 21, 1985 for weed control. Plots were fertilized with 30-60-60 lb/A, N-P₂O₅-K₂O, respectively, at planting and topdressed with 120 lb N/A on June 24, 1985. All plots were flooded on June 25, 1985. Plots were hand harvested, four center rows; 46.7 sq ft, on October 3, 1985.

Alsystin (4F) treatments were applied postflood with a CO₂ pressurized hand sprayer calibrated to deliver 20 gpa. Carbofuran (3G), the standard insecticide, was applied postflood with a shaker jar. Three core samples [3 5/8-in (dia) x 3-in (depth)] were pulled from each plot 24 days and 36 days postflood. Rice water weevil immatures (larvae + pupae) were washed from the soil and plant roots contained in the core samples and counted.

The test was designed as a randomized complete block design with three replications. An analysis of variance was run on the count data and means were compared using the LSD ($P = 0.05$).

RESULTS AND DISCUSSION

The number of rice water weevil immatures per core sample in the untreated check averaged 29.2, 24 days postflood and 27.9, 36 days postflood (Table 1). All rates and application times of alsystin significantly ($P < 0.05$) decreased immature counts at both sampling dates when compared to the untreated check.

Immature counts in the carbofuran treatment were lower than the untreated check at 24 days PoF but were not different at 36 days PoF. The 10 and 13 days PoF applications of alsystin increased yields when compared to the check.

These data show that an application of alsystin at 0.27 lb ai/A as late as 10 days PoF gave good rice water weevil control. The level of control in the 13 day PoF application, averaged across sampling dates, was lower than in the earlier timings. However, this treatment did increase yield and may indicate that the timing window could be extended past 10 days PoF.

Table 1. Rice water weevil control with postflood applications of alsystin.
Rice Research Station, Crowley, LA. 1985.^{a/}

Treatment	Rate	Days PoF applied	24 Days PoF		36 Days PoF		Yield lb/A
			RWW (L/C)	% Control	RWW (L/C)	% Control	
Alsystin	0.13 + oil	6	5.9*	79.8	10.8*	61.4	4351
	0.40	6	3.8*	87.1	6.0*	78.5	4269
	0.27	3	5.3*	81.8	11.0*	60.6	4067
	0.27	6	3.9*	86.7	7.1*	74.5	4100
	0.27	10	10.7*	63.5	2.8*	90.0	4511*
	0.27	13	13.3*	54.4	10.4*	62.6	5051*
Carbofuran	0.5	6	8.0*	72.6	21.0	24.7	4179
Check	---	--	29.2	----	27.9	----	4069

^{a/} Rate in lb ai/A; oil = 10 ml penetrator oil per 2 liters; PoF = postflood; RWW (L/C) = number of rice water weevil immatures/3 5/8-in (dia) x 3-in (depth) core samples; % Control = (ck-trt)/ck x 100; LSD (0.05) = 9.9 (7 to 19) and 10.2 (7 to 31); LSD yield (0.05) = 438; * = significantly different from check by LSD.

RICE WATER WEEVIL CONTROL WITH PREPLANT INCORPORATED APPLICATIONS OF PP-993

(A Progress Report)

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INTRODUCTION

PP-993 is a synthetic pyrethoid insecticide which has shown good activity against soil insect pests. In 1984, two rates and three application methods of PP-993 were evaluated for rice water weevil control. These data showed that pre flood and post flood applications were not effective and that a preplant incorporated application gave rice water weevil control comparable to the isofenphos standard. The objective of this research was to evaluate four rates of PP-993, applied preplant incorporated, for rice water weevil control.

MATERIALS AND METHODS

The rice variety 'Mars' was drill-seeded in plots 16-ft (length) x 4-ft (width) on May 31, 1985. Propanil (4 lb ai/A; June 24, 1985) and Bolero 10G (4 lb ai/A; June 25, 1985) were applied for weed control. Plots were fertilized with 120-60-60 lb/A, N-P₂O₅-K₂O, respectively, one day before flooding. Plots were flooded on June 26, 1985. The plots were drained on September 18, 1985 and harvested with a small-plot combine on September 26, 1985.

Preplant incorporated (PPI) treatments were applied on May 31, 1985. The insecticides were applied to the soil surface and then incorporated with a hand rake. All insecticides were applied with a hand-held shaker jar. Four rates, 0.1, 0.2, 0.3, and 0.4 lb ai/A, of PP-993 were tested. Carbofuran, 0.5 lb ai/A applied 5 days postflood, isofenphos, 2.0 lb ai/A applied PPI, and an untreated check were included in the test for comparisons.

Three core samples [3 5/8-in (dia) x 3-in (depth)] were pulled from each plot on July 16, 1986, 20 days postflood. Rice water weevil immatures (larvae + pupae) were washed from the soil and plant roots and counted. The test was designed as a randomized complete block design with four replications. Analyses of variance were run on the count and yield data. Means were compared using the LSD ($P = 0.05$).

RESULTS AND DISCUSSION

The rice water weevil infestation averaged 34.8 immatures per core in the untreated check (Table 1). All insecticide treatments had lower immature counts ($P = 0.05$) than the untreated check. PP-993 treatments had lower immature counts than the carbofuran standard but none of these treatments were different ($P = 0.05$) from the isofenphos PPI standard. PP-993, at all rates tested, and isofenphos increased rice yields when compared to the untreated check and the carbofuran standard.

PP-993 applied preplant incorporated at 0.1 to 0.4 lb ai/A did not interact with propanil, gave good rice water weevil control and increased rice yields. These data and the data collected in 1984 indicate that PP-993 is an effective rice water weevil insecticide and further tests should be conducted to determine its persistence, interaction with other rice herbicides, and toxicity to crawfish.

Table 1. Rice water weevil control with preplant incorporated applications of PP-993. Rice Research Station, Crowley, LA. 1985.^{a/}

Treatment	Rate	Application	RWW (L/C)	% Control	Yield (lb/A)
PP-993	0.1	PPI	9.8*	71.7	4944*
	0.2		6.8*	80.6	4962*
	0.3		3.2*	90.9	5007*
	0.4		2.3*	93.5	4985*
Amaze	2.0	PPI	7.1*	79.6	5067*
Carbofuran	0.5	PoF	15.8*	54.7	4450
Check	---		34.8	----	4333

^{a/} PPI = preplant incorporated; PoF = postflood; RWW (L/C) = number of rice water weevil immatures/3 5/8-in (dia) x 3-in (depth) core sample; % Control = (ck-trt)/ck x 100; LSD RWW (0.05) = 5.8; LSD yield (0.05) = 353; and * = significantly different from check by LSD (0.05).

EVALUATION OF RICE LINES REGENERATED FROM CELL CULTURE FOR RICE WATER WEEVIL RESISTANCE

(A Preliminary Report)

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INTRODUCTION

Research with other crops has shown that lines, originating from a disease susceptible source, regenerated from cell culture have variability for disease resistance. The mechanism for this somaclonal variability is not known. However, the possibility exists to exploit this technique to develop new sources of insect resistant germplasm. The objective of this research was to evaluate rice lines regenerated from cell culture for rice water weevil resistance.

MATERIALS AND METHODS

1984 Test. Five regenerated plants (R1) from each of five commercial rice varieties were grown in the field in 1983. Seed from each of the 25 R1 plants was harvested and stored separately so that R2 plants could be traced back to an individual R1 plant (source). R2 plants from each R1 source and check plants, seed derived from non-regenerated plants of each variety, were grown in the greenhouse. Thirty-day old seedlings were transplanted into single row field plots, 12-ft (length) on 3-ft centers with 2-ft spacing between plants within rows. The test was designed as split plot with three replications. Variety was the whole plot and R1 source was the split plot. Forty days after transplanting, rice water weevil immatures were washed from the soil and plant roots contained in a 6-in (dia) x 6-in (depth) core sample and counted. Since the sampling procedure was destructive, an additional two replications were planted for observation and obtaining plant height data. An analysis of variance was run on the immature count data and the height data.

1985 Test. Since there were no differences between R1 sources in the 1984 test, seed was bulked within a line for the 1985 test. Two additional lines, 'Saturn' (B) and Saturn (C), were also included in the test. The test was designed as a split-split-plot with six replications. Whole plots were insecticide treated and untreated, split-plots were rice lines, and split-split-plots were regenerated and non-regenerated. Plots were 3-ft in length and planted on 12-in centers. The insecticide treated plots received isofenphos, 2.0 lb ai/A, applied preplant incorporated and 12 days after permanent flood carbofuran, 1.0 lb ai/A, was applied. Fertilizer, 120-60-60 lb/A, was applied 1 day before permanent flood. Propanil, 4 lb ai/A, and Bolero 10G, 4 lb ai/A, were applied for weed control. Twenty days after flooding, rice water weevil immatures were washed from the soil and plant roots contained in a 3 5/8-in (dia) x 3-in (depth) core sample and counted. Plant height was taken at maturity.

RESULTS AND DISCUSSION

The rice water weevil immature count data in the untreated plots was used in these tests to indicate the relative level of antibiosis and/or antixenosis present in a particular line or seed source. Since the lines were planted side by side in the field and we relied on a natural rice water weevil infestation for evaluation, these mechanisms of resistance cannot be separated. A comparison between the plant heights in treated and untreated plots within a particular line or seed source was used to indicate the level of tolerance.

The immature counts per core sample, in 1984, ranged from 64, 'Lebonnet' (A) source 2, to 134, 'Brazos' source 1 (Table 1). No differences ($P > 0.05$) in immature counts were found between varieties or sources. In general, the overall mean immature count of the regenerated lines within a variety was higher than its respective parent. Saturn (A) was the only line tested that had consistently lower counts on the regenerated line than on the parent. All regenerated lines were shorter ($P < 0.05$) than their respective parent (Table 2).

In 1985, the immature counts per core sample in the untreated ranged from 8.7, Lebonnet (A) non-regenerated, to 24.7, Saturn (B) regenerated (Table 3). The overall mean immature count for the regenerated lines, 9.8 immatures/core, was higher ($P < 0.05$) than the overall mean count for the non-regenerated lines, 8.1 immatures/core. Comparisons (LSD $P < 0.05$) between regenerated and non-regenerated within a line in the untreated plots showed that regenerated 'Mars' and Brazos had higher immature counts than their respective non-regenerated parents.

The combination of isofenphos and carbofuran gave excellent, 98%, rice water weevil control and was reflected in the plant height data (Table 4). Overall, plants in the treated plots were taller, 98.5 cm ($P < 0.05$), than plants in the untreated plots, 94.9 cm. Comparisons (LSD $P < 0.05$) within a line and seed source, showed that regenerated Mars, Brazos, Lebonnet (B) and Saturn (A) and non-regenerated Saturn (A) and (B) plants grown in treated plots were taller than plants grown in untreated plots. Overall, regenerated plants were shorter, 88.4 cm ($P < 0.05$), than non-regenerated plants, 105.0 cm.

Based on the immature count data, an overall trend towards susceptibility was observed in the regenerated plants when compared to the non-regenerated plants. The plant height data indicates that regenerated Mars and Brazos are less tolerant of rice water weevil damage than their non-regenerated parents. Although the trend towards increased susceptibility in the regenerated plants is in the wrong direction, it does indicate that in terms of rice water weevil infestation and tolerance to damage the regenerated plants are not exact duplicates of their non-regenerated parents. This suggests that as rice lines are regenerated from cell culture they should be evaluated for rice water weevil resistance.

Table 1. Rice water weevil immatures per core sample on six rice lines regenerated from cell culture and their non-regenerated parent. Rice Research Station, Crowley, LA. 1985.

Variety	Source regenerated lines					Mean	Non-regenerated
	1	2	3	4	5		
Mars	93.7	99.7	102.7	95.0	78.0	93.8	84.0
Brazos	134.3	119.7	123.0	76.7	100.3	110.8	79.7
Bellemont	114.0	143.0	68.0	98.7	69.0	98.5	70.7
Lebonnet (A)	115.7	63.7	76.7	90.7	79.7	85.3	65.3
Lebonnet (B)	68.3	104.3	77.3	95.3	128.0	94.7	80.3
Saturn (A)	87.0	88.3	90.3	74.3	98.7	87.7	113.3

Table 2. Plant height (cm) of six rice lines regenerated from cell culture and their non-regenerated parent. Rice Research Station, Crowley, LA. 1985.

Variety	Source regenerated lines					Mean	Non-regenerated
	1	2	3	4	5		
Mars	80.0	78.5	82.5	83.5	81.5	81.2	96.5
Brazos	62.5	68.5	60.0	65.0	66.0	64.4	87.5
Bellemont	55.0	61.5	62.5	59.0	57.5	59.1	82.0
Lebonnet (A)	82.0	79.5	81.0	82.5	75.0	80.0	100.0
Lebonnet (B)	85.0	80.0	82.0	81.0	82.5	82.1	94.0
Saturn (A)	80.0	82.5	71.0	75.0	85.0	78.7	102.5

Table 3. Number of rice water weevil immatures per core found on eight regenerated rice cultivars and their non-regenerated parents. Rice Research Station, Crowley, LA. 1985.

Cultivar	Treated		Untreated	
	Regenerated	Non-regenerated	Regenerated	Non-regenerated
Mars	0.0	0.5	23.2*	11.3
Brazos	0.2	0.2	24.5*	13.0
Bellefont	0.5	0.5	11.2	14.7
Lebonnet (A)	0.2	0.5	12.2	8.7
Lebonnet (B)	0.2	0.7	14.7	11.7
Saturn (A)	0.7	0.0	24.2	22.7
Saturn (B)	0.2	0.5	24.7	24.2
Saturn (C)	0.3	0.5	19.5	19.5
Mean		0.3		17.5

Table 4. Plant height (cm) at maturity of eight regenerated rice lines and their non-regenerated parents. Rice Research Station, Crowley, LA. 1985.

Cultivar	Regenerated		Non-regenerated	
	Treated	Untreated	Treated	Untreated
Mars	93.2*	83.3	85.0	85.8
Brazos	80.3*	64.2	93.0	93.8
Bellefont	67.5	70.0	80.8	79.0
Lebonnet (A)	87.5	89.0	115.0	112.2
Lebonnet (B)	98.3*	95.0	115.8	114.2
Saturn (A)	97.5*	87.5	122.5*	110.0
Saturn (B)	101.7	103.3	120.0*	112.5
Saturn (C)	98.3	97.5	119.2	121.3
Mean		88.4		105.0

PHEROMONE STUDIES ON THE RICE STALK BORER

(A Preliminary Report)

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INTRODUCTION

The rice stalk borer, Chilo plejadellus Zinken, occurs in rice fields in the southeastern United States. In general, C. plejadellus damage has not been economically significant for the past several years but it has recently been reported as infesting large parts of the rice producing areas of Arkansas and Mississippi. Insecticide control is not practical because insecticide efficiency is uncertain, infestations are irregular, and there are no efficient methods to monitor C. plejadellus populations. Stalk borer mating is known to be controlled by a female pheromone secretion. The objectives of the present study were to identify the female sex pheromone of the C. plejadellus moth and to determine the effectiveness of the pheromone as a monitoring tool.

MATERIALS AND METHODS

Insect Material and Preparation of Extracts. Larvae of C. plejadellus were collected from rice plants at the Rice Research Station at Crowley, Louisiana and reared until pupation on an artificial diet similar to that developed by Davis (1976) for the southwestern corn borer, Diatraea grandiosella Dyar. The colony was maintained on a 14L:10D photoperiod at 28°C and 65% RH. Pupae were separated by sex and kept in glass containers (7.8 in diam. x 3.1 in high) for adult emergence. Twentyfour hours after emergence, female moths were kept in the dark cycle for 3 hours or until they assumed the calling position by exposing the genitalia (Tatsuki et al., 1975). Extracts were prepared by clipping the last abdominal segment and extracting its contents in 10 µl of HPLC grade heptane for 3 minutes at 25°C. The procedure was repeated every day until a 500 female equivalent was obtained. The extract was transferred to a 1 ml reaction vial and kept at -10°C until chemical analysis.

Chemical Analysis. Extracts were concentrated under an argon stream to a 5 µl volume. A 1 µl sample was injected into a Hewlett Packard model 5840A gas chromatograph equipped with a 30 m OV-1 bonded phase capillary column and a flame ionization detector. The instrument was programmed at 10°C/min from 70 to 200°C with a Helium carrier gas flow of 46 cm/sec. Structure elucidation was obtained by GC-MS analysis using a Hewlett Packard model 5985 mass spectrometer equipped with a 30 m OV-1 bonded phase capillary column and programmed at the same conditions as the gas chromatograph. Final characterization was made possible by mass spectral analysis together with comparison to a synthetic standard.

Field Tests. Field trapping studies were conducted using Pherocon No. 3302-0 traps obtained from Trece Inc., Salinas, California. Synthetic pheromone was obtained from Shin-Etsu Company Toyko, Japan Cat. No. 76870. The pheromone was combined with an equal amount of 2,6-di-tert-butyl-p-cresol (BHT) as an antioxidant and dissolved in HPLC grade heptane to obtain the desired concentration. Two hundred μ l of the pheromone solution were dispensed onto a septa Cat. 2-7131-10 obtained from the Bittner Co., Norcross, Georgia supplied by Fisher Scientific. Traps were suspended 3 ft above ground level from steel conduit tubes and spaced 150 ft apart from each other. Concentration ratio studies were conducted at the Rice Research Station in Crowley, Louisiana for 4 weeks beginning in the third week of April. After the most attractive concentration was determined, the effectiveness of the pheromone trap to a fluorescent light trap was compared.

RESULTS AND DISCUSSION

Gas chromatographic analysis of C. plejadellus female extracts combined with mass spectroscopy indicated the presence of one component with a retention time of 19.51 minutes, a molecular ion of m/z 266 (2.3%, M^+) and a molecular formula of $C_{18}H_{34}O$. Its chemical structure corresponded to (Z)-13-octadecenal and was confirmed by mass spectra analysis and comparison to a known standard.

The 3.0 mg concentration of (Z)-13-octadecenal trapped more C. plejadellus males than any other concentration (Table 1), the 0.1 mg concentration was comparable to the 3.0 mg only during the fourth week of April. Concentrations of 0.03 mg and 0.3 mg were considerably less attractive.

The use of pheromone traps proved to be more effective in detecting C. plejadellus populations than the light trap (Figure 1). Pheromone trap catches were greater than those in the light trap in all but one trapping week. Population curves were similar in both traps, with major population peaks occurring in April and August, but the pheromone traps provided population information as much as 2 weeks before the light trap. This is an interesting finding since earlier detection may make insecticidal treatment of moth populations possible before mated females oviposit. In contrast, the light trap detected peak populations later, when insect larvae had already infested the rice stems, and control was not feasible.

These results indicate that rice planted at the LSU Rice Research Station is infested by C. plejadellus. At the present time, this insect is not a major pest. However, monitoring studies should be continued to determine if infestations continue to increase.

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Table 1. Attraction of male C. plejadellus moths to traps baited with (Z)-13-octadecenal. Rice Research Station, Crowley, LA. 1985.

Trapping period	$\bar{X} \pm \text{SE}$ males caught/week/trap				
	Concentration (mg/septa)				
	0.03	0.3	1.0	3.0	(Control)
4/3	0	6.0 $\pm$ 2.8	11.3 $\pm$ 5.3	21.3 $\pm$ 7.3	0
4/4	0.3 $\pm$ 0.1	1.3 $\pm$ 0.6	4.0 $\pm$ 1.4	3.6 $\pm$ 1.3	0
5/1	0	0	0	0.6 $\pm$ 0.3	0
5/2	0	0	0.3 $\pm$ 0.1	0	0
TOTAL	0.3 $\pm$ 0.1	3.6 $\pm$ 1.1	5.2 $\pm$ 1.5	8.5 $\pm$ 3.0	0

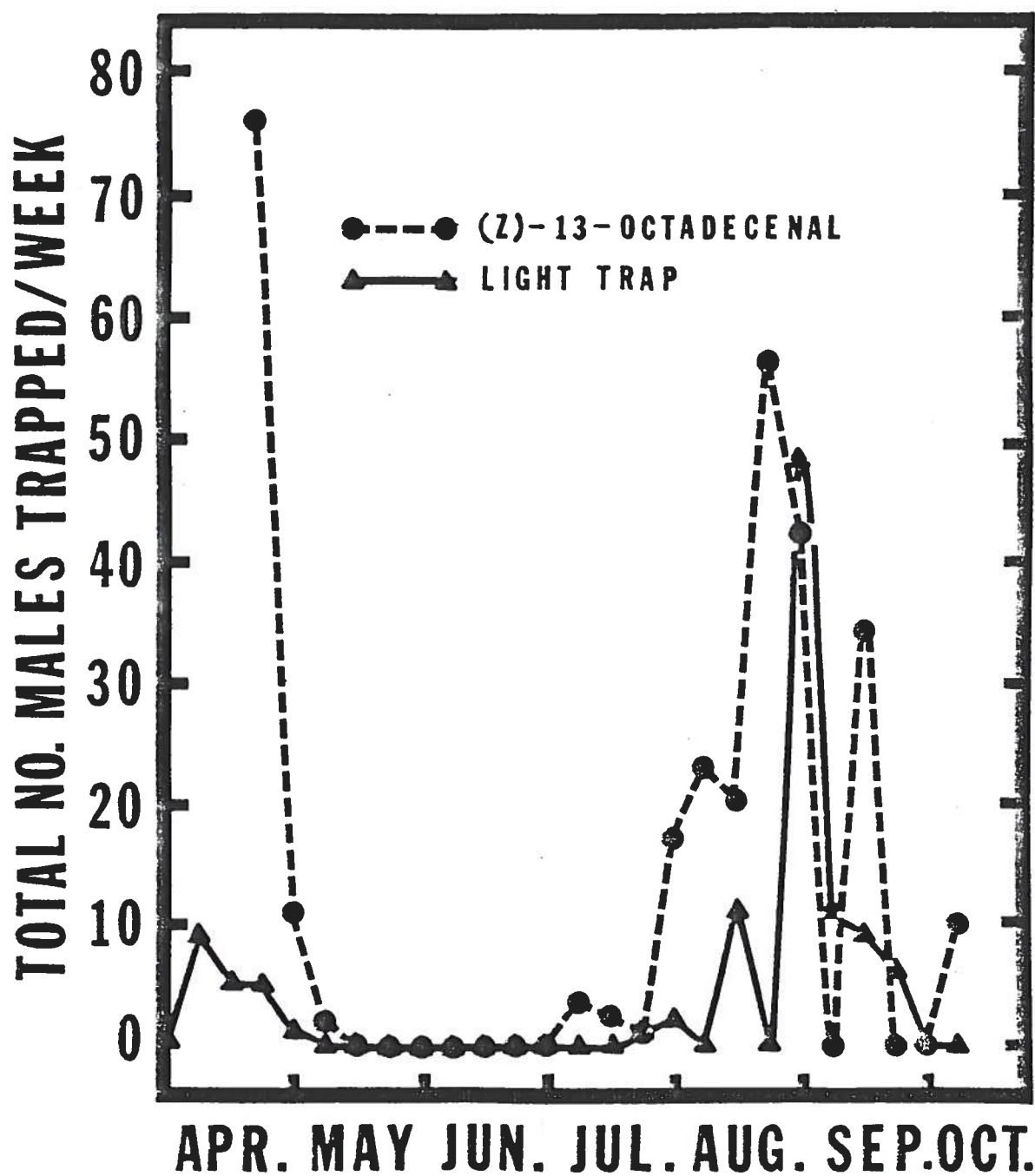


Figure 1. Comparison of *C. plejadellus* catches from a light trap and traps baited with 3.0 mg of (Z)-13-octadecenal.

VARIOUS SPECIES OF WEEVILS INFESTING LATE SEASON RICE

(A Preliminary Report)

C.M. Smith, J.F. Robinson, Maureen Riley, and Colwell Cook

INTRODUCTION

The rice water weevil, Lissorhoptrus oryzophilus Kuschel, is the major weevil found feeding on rice in Louisiana. Several other types of weevils have been noted in the past, however, from collections on rice and from light traps near rice fields. The objective of this study was to determine what species of aquatic weevils were present on rice other than the rice water weevil.

MATERIALS AND METHODS

Four 100-weevil samples were taken from a field of 'Mars' rice on August 16, 1985 at the LSU Rice Research Station. The weevils were hand-collected by four different individuals from the leaves of rice plants when weevil leaf scarring was noted. After collection; weevils were taken to the laboratory, frozen and pinned. Pinned specimens were examined with a binocular microscope at 20X and sorted into different groups, based on external features. Representative specimens from each group were sent to Dr. C.W. O'Brien, Florida State University, for identification.

RESULTS AND DISCUSSION

Of all weevils collected, most (81%) were rice water weevils. However, a slightly larger, long snouted weevil, Onychylis longulus LeConte, was found to compose 19% of the sample. Several other species of weevils were also collected occasionally, but their numbers made up less than 1% of all the weevils sampled. These species included Bagous pusillus LeConte; Perigaster eretura Host.; Eudiagogus rosenschoeldi Fahr.; and Lixellus lutulentus (Boh.).

Though O. longulus did compose about one-fifth of the weevils samples, it is not known to be a pest on rice. Further observations will be made in the future to determine if O. longulus infests rice at other times in the season, and to determine if it is capable of completing development on rice.

SCREENING OF ORYZA SPECIES FOR RICE WATER WEEVIL RESISTANCE

(A Progress Report)

E.M. Nowick and J.F. Robinson

INTRODUCTION

Screening of wild and weedy species of Oryza for resistance to rice water weevil (RWW) has continued in the last year. As no sources of high level resistance to this insect have been identified in the world collection to date, it is hoped that a source of resistance can be identified among the other species closely related to cultivated rice. An additional 35 accessions were evaluated in the last season.

MATERIALS AND METHODS

Dormancy was broken in the species seed as previously reported. Thirty-day old seedlings were transplanted into the field in a split plot arrangement with two replications. Whole plots were either treated with 2.0 lb ai/A isofenphos or left untreated, while the subplots were varieties. Thirty days after transplanting individual plants were uprooted and the number of RWW larvae per plant counted from root washes. Each root system was also visually rated for root pruning on a scale of 1 to 9 with one being no damage.

RESULTS AND DISCUSSION

Of the 35 accessions tested, none had significantly fewer larvae on their root systems than the check variety Mars (Table 1). Several were not significantly different from Mars but most had higher larval counts and untreated plants always had many more larvae than treated. A number of the accessions showed little root damage on the visual rating scale although they supported a large population of larvae indicating that some tolerance may be present. Screening of more species will continue as seed becomes available.

Table 1. Larval counts and root ratings in treated and untreated plots of Oryza species. Rice Research Station, Crowley, LA. 1985.

Line	Larval count	Root rating
	----UT/T----	----UT/T----
O. alta Ac 100161	30/5.00	4/2
O. barthii Ac 101254	219.50/12.00	7/4
" Ac 101304	68/11.00	9/2
O. glaberrima Ac 101855	247.50/38.50	5/2
" Ac 102214	146.50/5.50	5/2
" Ac 102445	191/33	5/2
" Ac 102554	247/35	2/2
" Ac 102555	221.50/13.00	5/2
" Ac 102710	86.50/8.50	2/2
" Ac 102838	251.00/53.00	5/2
" Ac 103090	136.50/13.00	4/2
" PI 269630	153.50/24.50	4/2
O. nivara Ac 101146	239.50/14.50	5/2
" Ac 101508	231.50/31.50	7/2
" Ac 102167	256/23	7/2
" Ac 102169	233.50/48.00	4/2
" Ac 102178	200.50/36.00	4/2
" Ac 102842	156.00/28.50	8/2
" Ac 103317	148.50/64.00	4/2
" Ac 103407	253.00/64	6/2
" Ac 103835	140/12	8/2
" PI 360791	458.50/119.5	8/2
O. perennis Ac 100639	191.00/27	7/2
" Ac 103846	195/38	7/2
O. rufipogon Ac 100924	123.50/40	5/2
" Ac 103817	96.50/14	2/2
" Ac 10647	95.00/26.5	9/2
Unknown Ac 100597	112.00/10.5	7/2
" Ac 100665	164.50/36	7/2
" Ac 102429	201.00/42.5	3/2
" Ac 102468	184.50/70.5	9/2
" Ac 102705	120.00/23	2/2
" AF 27-3	214.50/36.5	5/2
" AF 27-3	207.00/11.5	7/2
" AF 27-3	146.00/5	7/2
Mars	30.50/5	5/2

DISEASE CONTROL STUDIES

1985 RICE DISEASE SURVEY

(A Progress Report)

D.E. Groth and C.A. Hollier^{1/}

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 and bacterial 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. 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.

The objective of this study was to identify and estimate severity of the diseases occurring in the rice producing regions of Louisiana. This information is useful for setting priorities in the breeding for disease resistance in the rice improvement program at the L.S.U. Rice Research Station and is used in establishing the need for new fungicides. In addition, earlier detection of new or previously minor diseases causing significant crop losses will provide important information for the development of new control practices.

MATERIALS AND METHODS

The disease survey of commercial rice fields was conducted in the spring and summer of 1985. Areas surveyed were Acadia, Allen, Jefferson Davis, and Vermilion parishes in southwest Louisiana and Morehouse and Richland parishes in northeast Louisiana. Fifty fields were sampled in the spring and 64 were sampled in the summer.

Seed and seedling diseases. Fields, which had been planted 1 to 2 weeks before, were selected at random. Fields were sampled in March and April in the southwest parishes and in May in the northeast parishes. Ten sample areas were randomly selected in each field by throwing a 1 ft² wire square. Within each area, number of seeds infected with water molds and seedlings were counted.

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Late-season diseases. Fields with maturing rice were selected in the same manner as in the spring. Ten sampling sites were inspected in each field by walking a predetermined number of paces through the field and stopping at random locations. Disease severities and/or incidence were recorded for each disease. Sheath blight, brown spot, leaf smut (*Entyloma oryzae*), and narrow brown spot were rated on 0 to 9 scales where 0 indicated no infection and 9 a severe infection (2). Blast was estimated by the percent of heads infected, where 0 = none and 9 = 90% or more. The variety of rice was determined for each field whenever possible.

Variety trial. A variety trial was planted at the Rice Research Station in Crowley, LA to evaluate the response of common commercial varieties to diseases in the field. Tested were the long-grain varieties 'Lemont', 'Labelle', 'Lebonnet', 'Newbonnet', 'Bond', 'Tebonnet', 'TORO-2', 'Skybonnet', and 'Leah', and the medium-grain varieties 'Saturn', 'Pecos', and 'Mars'. Fertilizer was preplant incorporated at a rate of 60-60-60 lb/A N-P₂O₅-K₂O 1 to 2 inches deep using a small grain drill. Each variety was drill seeded at 100 lb/A on April 30, 1984 and flushed to promote germination. Plots consisted of 7 rows 16 ft long spaced 7 inches apart. The experiment was arranged in a randomized complete block design with four replications. Propanil was applied at 4 lb/A to control weeds. A permanent flood was established as soon as seedlings had emerged 2 to 4 inches, carbofuran was applied to control rice water weevils, and plots were topdressed with 100 lb/A N as Ammonium sulfate before flooding. All plots were inoculated with a moist, autoclaved rice grain:rice hull (1:2) medium culture of *Rhizoctonia solani* (isolate LR-172) at the green ring growth stage at the rate of 100 ml of inoculum per plot. Plots were rated for disease severities at maturity. The center four rows (35 ft²) were harvested with a small plot combine. Sample weight and moisture content were determined and grain yields were calculated at 12% moisture for each variety.

RESULTS AND DISCUSSION

The most common diseases found in Louisiana rice fields were water molds, sheath blight, blast, brown spot, leaf smut, and narrow brown leaf spot. Incidents of kernel smut and sheath rot were also reported in the state but did not appear in any of the fields sampled. In 1985, stand reductions were 24 and 12% in the southwest and northeast regions (Tables 1, 2, and 5), respectively, with symptoms appearing in 96 and 78% of the sample areas, respectively.

In 1985, sheath blight was the most severe disease on rice in Louisiana (Tables 3, 4, and 6). Sheath blight was 1.4 times greater on long-grain varieties in the southwest region than on the long-grain varieties in the northeast and 4.9 times greater than on medium-grain varieties. Blast was very severe on the variety Newbonnet in 1985 and was probably the second most important disease. Brown spot, leaf smut, and narrow brown leaf spot were also common in 1985. Overall, disease pressure was higher in 1985 than in 1984 (1).

Sheath blight was found to be the number one disease problem in Louisiana rice fields. This is probably due to the crop rotation with soybeans, which is also susceptible to the pathogen and resulting in the maintenance of high inoculum levels in the soil. Only the long-grain varieties were heavily diseased since the medium-grain varieties have an intermediate level of resistance to the disease. In 1984, 18% of all the fields inspected could have

Table 1. Disease survey of commercial rice fields in northeast Louisiana in 1985 at planting time.

Variety	Seedling/ft ² ^{a/}	Water molded seed/ft ² ^{b/}	Percent samples w/water molds ^{c/}	Stand reduction to water mold ^{d/}
<u>Morehouse Parish</u>				
			<u>Drill-seeded</u>	
Long	20	0	0	0
Long	29	0	0	0
Long	36	0	0	0
Long	27	0	0	0
Long	29	0	0	0
Long	25	0	0	0
Long	<u>19</u>	<u>0</u>	<u>0</u>	<u>0</u>
Average:	26.4	0	0	0
			<u>Water-seeded</u>	
Long	20	2.3	80	10.3
Long	11	2.0	80	15.4
Long	<u>14</u>	<u>2.4</u>	<u>80</u>	<u>14.6</u>
Average:	15.0	2.2	80	12.8
<u>Richland Parish</u>				
			<u>Drill-seeded</u>	
Long	22	0	0	0
Long	29	0	0	0
Long	32	0	0	0
Long	39	0	0	0
Long	31	0	0	0
Long	30	0	0	0
Long	31	0	0	0
Long	21	0	0	0
Long	<u>29</u>	<u>0</u>	<u>0</u>	<u>0</u>
Average:	26.4	0	0	0
			<u>Water-seeded</u>	
Long	17	1.6	70	8.6

a/ Average number of seedlings present in a 1 ft² area.

b/ Average number of rotted seeds present in a 1 ft² area.

c/ Percent of 1 ft² sample areas with water mold signs present on soil surface.

d/ Present stand reduction due to water molds.

Table 2. Survey of commercial rice fields in southwest Louisiana in 1985 at planting time.

Variety	Seedling/ft ² ^{a/}	Water molded seed/ft ² ^{b/}	Percent samples w/water molds ^{c/}	Stand reduction to water mold ^{d/}
<u>Water-seeded</u>				
Acadia Parish:				
Medium	24.0	7.5	100	23.8
Long	19.6	11.2	100	36.4
Long	11.7	12.0	100	50.6
Long	27.9	12.8	100	31.4
Medium	20.5	17.2	100	45.6
Medium	30.8	11.1	100	26.5
Medium	38.0	6.0	100	13.6
Long	19.7	16.3	100	45.2
Long	27.7	4.7	100	14.5
Medium	<u>14.4</u>	<u>8.7</u>	<u>100</u>	<u>37.7</u>
Average:	23.4	10.8	100	31.6
Allen Parish:				
Saturn	13.1	2.2	70	14.4
Labelle	22.8	2.8	80	10.9
Lemont	37.6	5.3	90	12.4
Long	16.6	4.0	100	19.4
Long	9.5	4.7	100	33.1
Long	<u>31.6</u>	<u>4.7</u>	<u>90</u>	<u>12.9</u>
Average:	21.8	4.0	88.3	15.5
Jefferson Davis Parish:				
Medium	19.4	9.4	100	32.6
Lemont	32.8	2.1	80	6.0
Long	35.2	6.8	100	16.2
Long	18.6	6.0	100	24.3
Medium	21.1	8.8	90	29.4
Lemont	11.3	9.9	100	46.7
Long	20.7	5.1	100	19.8
Long	<u>32.7</u>	<u>5.9</u>	<u>90</u>	<u>15.3</u>
Average:	24.0	6.8	95	21.9

CONTINUED.

Table 2. CONTINUED.

Variety	Seedling/ft ² ^{a/}	Water molded seed/ft ² ^{b/}	Percent samples w/water molds ^{c/}	Stand reduction to water mold ^{d/}
<u>Water-seeded</u>				
Vermilion Parish:				
Medium	23.0	10.6	100	
Long	24.9	5.0	90	
Medium	39.2	12.0	100	
Long	27.1	6.4	100	
Medium	40.6	7.9	100	
Medium	<u>25.6</u>	<u>7.1</u>	<u>100</u>	
Average:	28.5	6.1	98.3	

a/ Average number of seedlings present in a 1 ft² area.

b/ Average number of rotted seeds present in a 1 ft² area.

c/ Percent of 1 ft² sample areas with water mold signs present on soil surface.

d/ Percent stand reduction due to water molds.

Table 3. Disease survey of commercial rice fields in southwest rice growing parishes of Louisiana at maturity in 1985.

Variety	Sheath blight ^{a/}	Brown spot ^{a/}	Leaf smut ^{a/}	Narrow brown ^{a/}	Blast ^{b/}
Acadia Parish:					
Long	6.1	6.3	1.7	0.8	1.2
Long	5.1	3.7	3.4	0.9	0
Mars	0.5	3.9	0.9	0.6	0
Mars	1.1	3.5	0.8	0.7	0
Mars	0.8	3.5	1.4	0.9	0
Mars	0.4	1.6	0.0	0.3	0.3
Mars	0.6	1.7	0.2	0.3	0
Mars	2.8	2.2	2.2	0.3	0.5
Newbonnet	3.8	5.3	0.6	0.7	1.7
Saturn	1.6	2.2	2.0	0.8	0
Lemont	4.6	4.5	0.7	1.0	0
Long	4.7	3.2	2.4	0.4	0
Lemont	4.6	6.9	3.6	3.6	0
Jefferson Davis Parish:					
Newbonnet	3.3	2.2	2.1	0.1	0
Lemont	4.3	2.1	2.5	0.6	0
Labelle	3.7	1.6	1.6	1.4	0
Lemont	5.8	0.8	1.5	0.3	0
Lemont	6.2	2.5	0.6	0.5	0
Labelle	5.2	1.2	1.0	0.4	0
Labelle	3.0	3.6	2.2	1.1	0
Labelle	1.2	1.6	1.5	0.0	0
Lemont	3.2	3.7	1.0	4.3	0
Mars	0.4	1.6	0.3	0.6	0
Mars	0.3	0.6	0.2	0.1	0
St. Landry Parish:					
Long	5.8	1.8	3.7	1.2	0
Mars	0.8	1.8	2.8	1.2	0
Tebonnet	2.2	2.6	3.0	0.5	0
Newbonnet	3.0	2.0	0.5	0.1	4.0

CONTINUED.

Table 3. CONTINUED.

Variety	Sheath blight ^{a/}	Brown spot ^{a/}	Leaf smut ^{a/}	Narrow brown ^{a/}	Blast ^{b/}
Vermilion Parish:					
Lemont	6.4	2.3	4.4	0.3	0
Mars	0.5	2.5	0.6	0.4	0
Lemont	7.1	3.6	0.5	0.2	0
Lemont	2.6	4.3	0.4	0.3	0
Mars	1.5	2.6	1.6	0.3	0
Mars	2.2	2.2	1.8	0.0	0
Long	1.7	4.1	2.3	0.0	0
Lemont	5.8	2.0	2.4	0.4	0
Lemont	4.4	4.9	3.1	2.9	0
Mars	0.9	2.6	2.8	0.1	1.3
Newbonnet	2.4	2.0	0.6	0	0
Mars	0.3	1.7	2.3	0	0
Mars	0.4	3.1	1.3	0	0
Newbonnet	3.2	4.8	0	0	4.2
Long	1.2	4.7	0.5	1.9	0

^{a/} Plants rated on 0 to 9 scale with 0 = no symptoms and 9 = severe disease.

^{b/} Plants rated on 0 to 9 scale with 0 = no infection and 9 = 90 to 100% of heads with rotten neck symptoms.

Table 4. Disease survey of commercial rice fields in northeast rice growing parishes of Louisiana at maturity in 1985.

Variety	Sheath blight ^{a/}	Brown spot ^{a/}	Leaf smut ^{a/}	Narrow brown ^{a/}	Blast ^{b/}
Morehouse Parish:					
Lemont	7.7	3.6	0.1	2.0	0
Lemont	5.5	2.5	0.4	1.0	0
Lemont	1.9	1.7	0.7	0.5	0
Lemont	5.9	1.4	0.6	0.3	0
Lemont	2.6	0.3	0.0	0.2	0
Lemont	0.8	3.0	0.1	1.8	0
Newbonnet	2.4	1.0	1.0	1.0	3.5
Newbonnet	0.5	0.2	0.4	0.0	6.4
Newbonnet	1.4	1.0	1.0	1.0	1.6
Newbonnet	2.6	2.0	0.8	2.1	0.9
Richland Parish:					
Lemont	3.8	3.2	3.0	1.8	0
Lemont	2.7	1.0	3.0	2.3	0
Starbonnet	1.5	3.4	3.0	1.0	0
Newbonnet	2.9	2.5	3.2	1.0	3.2
Lemont	3.6	1.6	1.0	1.0	0
Lemont	4.4	2.6	3.0	1.0	0
Lemont	3.9	3.0	2.4	1.0	0
Newbonnet	2.1	2.0	1.3	1.0	1.4
Newbonnet	2.7	1.0	1.0	0.0	1.0
Newbonnet	1.0	1.0	1.2	0.2	4.8
Lemont	7.2	0.3	0.2	0.0	0

^{a/} Plants rated on 0 to 9 scale with 0 = no symptoms and 9 = severe disease.

^{b/} Plants rated on 0 to 9 scale with 0 = no infection and 9 = 90 to 100% of heads with rotten neck symptoms.

Table 5. Disease survey of commercial rice fields in the southwest and northeast rice growing parishes of Louisiana in 1985 at planting time.

	Plants/ft ^{2a}	Water mold/ ^b ft ²	% Stand ^c reduction	Percent samples w/water molds ^d
<u>Southwest Region:</u>				
Water seeded (30)	24.1	7.7	24	96%
Range:	(9.5-40.6)	(2.2-17.2)		
<u>Northeast Region:</u>				
Water seeded (4)	15.5	2.1	12	78%
Range:	(11-20)	(1.6-2.4)		
Drilled seeded (16)	26.4	0	0	0
Range:	(19-36)	--	--	--

^a Average number of seedlings present in a (1 ft²) area.

^b Seeds rotted by water mold per ft².

^c Percent stand reduction calculated by (water mold/ft² ÷ plants/ft + water mold/ft²) x 100.

^d Percent of 1 ft² sample areas with sights of water molds present on soil or seeds.

^e Number of fields sampled of each planting method.

Table 6. Disease survey of commercial long- and medium-grain rice fields in the southwest and northeast rice growing parishes of Louisiana in 1985 at plant maturity.

Variety	Sheath blight ^a	Brown spot ^a	Leaf smut ^a	Narrow brown ^a	Blast ^c
<u>Southwest Region</u>					
<u>Long-grains</u>					
Lemont (11) ^d	5.0	3.4	1.9	1.3	0
Newbonnet (5)	3.1	3.3	0.8	0.5	2.3
Labelle (4)	3.3	2.0	1.6	0.7	0
Tebonnet (1)	2.2	2.6	3.0	0.5	0
Unknown (6)	<u>4.1</u>	<u>4.0</u>	<u>2.3</u>	<u>0.9</u>	<u>0.2</u>
Average:	4.4	3.3	1.8	0.9	0.5
Range:	(1.2-7.1)	(0.8-6.9)	(0-4.4)	(0-3.6)	(0-4.2)
<u>Medium-grains</u>					
Mars (15)	0.9	2.3	1.3	0.4	0.1
Saturn (1)	<u>1.6</u>	<u>2.2</u>	<u>2.0</u>	<u>0.8</u>	<u>0</u>
Average:	0.9	2.3	1.3	0.4	0.1
Range:	(0.3-2.8)	(0.6-3.9)	(0.1-2.8)	(0-1.2)	(0-0.5)
<u>Northeast Region</u>					
<u>Long-grains</u>					
Lemont (12)	4.2	2.0	1.2	1.1	0
Newbonnet (8)	2.0	1.3	1.2	0.8	1.1
Starbonnet (1)	<u>1.5</u>	<u>3.4</u>	<u>3.0</u>	<u>1.0</u>	<u>0</u>
Average:	3.2	2.4	1.3	1.0	0.4
Range:	(0.5-7.7)	(0.2-3.6)	(0-3.2)	(0-2.3)	(0-6.4)

^a Plants rated on a 0 to 9 scale, 0 = no symptoms, 9 = severe infection.

^b Number of plants showing symptoms in 1 ft².

^c Rated 0 = no infection, 9 = 90 to 100% infected.

^d Number of fields sampled of each variety.

justified using a fungicide to control sheath blight (1). In 1985, this increased to 25% of all fields or 32% of the long-grain fields inspected. The percentage of the fields needing treatment was probably higher since some of the inspected fields were treated with fungicides. In general, sheath blight was less serious in northeast Louisiana, which is a newer rice growing area, but several severely affected fields indicated that disease pressure is building and will be an increasing problem in the future. Development of disease resistant varieties, cultural control practices, and new fungicides will be a prime objective in rice pathology for the foreseeable future.

Water molds were more of a problem in 1984 than 1985 (1). Farmers used fungicide seed treatments and increased seeding rates to overcome this problem associated with water seeding of rice. However, in 1985, disease pressure was light and many farmers ended up with high plant densities which could have favored disease development later in the year. The rice farmer can expect some water mold because of its widespread occurrence even in the newer rice growing areas of the northeast. Therefore, caution must be used in deciding on seeding rates to achieve adequate plant densities while avoiding overcrowding.

Blast was unexpectedly a severe problem on the new long-grain variety Newbonnet in 1985. The main problem was "rotten-neck", in which the pathogen infects the stem below the seedhead. This infection reduces seed filling and causes the head to fall over or break off. Farmers planting this variety should closely monitor the crop for blast development and the need for a fungicide treatment.

The results of the variety trial are reported in Table 7. Foliar disease reactions were very similar to those found in commercial rice fields. Sheath blight severity was also similar to that in commercial fields.

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Table 7. Rice variety trial disease ratings and yields in 1985 at the Rice Research Station, Crowley, LA.

Variety	Sheath blight	Brown spot	Narrow brown	Leaf smut	Yield lb/A
Saturn	1.8	1.5	2.5	1.0	3850
Mars	2.8	0.8	0.5	1.3	6302
Pecos	2.0	0.8	0	0.8	7097
TORO-2	5.5	0.3	0	0.3	5861
Labelle	7.5	1.0	4.8	1.5	4374
Tebonnet	5.8	2.3	4.0	3.0	4302
Bond	7.8	3.0	3.5	5.0	4433
Leah	4.5	1.0	0.3	0.0	6360
Lemont	8.0	3.3	3.5	1.0	6167
Lebonnet	7.3	2.0	3.8	2.3	6082
Skybonnet	8.0	1.3	4.3	1.3	5596
Newbonnet	4.5	2.3	1.0	0.3	6306

1985 DISEASE NURSERIES

(A Progress Report)

D.E. Groth, M.C. Rush, M.J. Frey, and J. Nugent

INTRODUCTION

Disease nurseries were planted at the Rice Research Station, Crowley, Louisiana, to evaluate resistance levels in various lines, varieties and selections of rice (Oryza sativa L.) to sheath blight (Rhizoctonia solani), brown spot (Bipolaris oryzae), narrow brown leaf spot (Cercospora oryzae) and leaf smut (Entyloma oryzae). The objectives of this experiment were: (1) to determine the response of available commercial varieties and advanced breeding lines to each disease in the field; and (2) to identify sources of resistance and susceptibility to each disease for use in varietal development and inheritance studies.

MATERIALS AND METHODS

Sheath blight nursery. The sheath blight nursery was planted on May 1, 1985. Four grams of seed of each entry were drill seeded into each of three 4-ft rows. Row spacing was 10 inches with 3 ft between tiers of rows. On May 15, Propanil was applied at 4 lb/A to control weeds. On May 20, 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 on June 25. 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 infection severity on a 0 to 9 scale previously reported (1).

Foliage disease nursery. The foliage disease ratings were collected from the sheath blight nursery. All inoculum was from natural sources. Approximately 35 days after heading, the entries were rated for brown spot, narrow brown leaf spot and leaf smut infection severity using 0 to 9 scales with 0 indicating no infection and 9 very severe infection. The disease classes were as previously reported (1).

RESULTS AND DISCUSSION

Disease reactions of the 700 entries in the nurseries to sheath blight, narrow brown spot, leaf smut and brown spot are listed in Table 1. In the foliar disease nursery, 642 entries (92%) received resistant ratings (0 to 3) for brown spot, 253 (36%) were resistant (0 to 1 rating) to narrow brown spot and 148 (21%) were resistant (0 to 1 rating) to leaf smut. In the sheath blight nursery, 46 long-grain lines, entries 17, 18, 29, 39, 40, 78, 123, 282, 355, 436, 529, 532, 609, 636, 637, 642, 644, 646, 650, 651, 654, 655, 658, 660, 661, 664, 665, 668, 669, 670, 671, 672, 674, 677, 678, 681, 683, 684, 685, 686, 687, 688, 690, 691, 693, and 694, showed a resistant (0 to 3) reaction to sheath blight. Some of these entries were late maturing and resistance may have been due to dry weather late in the season. Thirty-three entries exhibited multiple disease resistance to sheath blight (0 to 3), brown spot (0 to 3) narrow brown leaf spot (0 to 1) and leaf smut (0 to 1). These were entries 17, 18, 39, 40, 78, 79, 118, 123, 195, 282, 355, 532, 529, 612, 626, 627, 628, 646, 654, 655, 658, 659, 660, 661, 664, 665, 669, 670, 674, 687, 688, 690, and 693.

In 1985, rice disease pressure was moderate in Louisiana. In the sheath blight nursery, disease pressure was moderate in severity and, in addition, 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 light and leaf smut and narrow brown spot pressure was moderate in 1985. As a result of these environmental conditions, the severity of these tests were moderate as compared to other years.

LITERATURE CITED

1. Groth, D.E. and M.C. Rush. 1985. Rice disease assessment keys. Ann. Prog. Rpt., Rice Res. Stn., La. Agri. Exp. Stn., L.S.U. Agricultural Center, 77: .

Table 1. Disease reaction of entries in the 1985 disease nurseries to sheath blight, leaf smut, narrow brown spot and brown spot. Rice Research Station, Crowley, LA.

Entry No.	Identification number or variety	Grain type	Shth _a / blgt	Leaf _b / smut	Nar c/ br sp	Brown Spot		Days to heading
						Ho	d/ Ho-N Ho-S	
1	RU 821031	M	4	4	1	2	5 2	87
2	RU 8502002	M	6	1	0	3	2 3	80
3	RU 8403113	L	7	3	4	2	2 1	76
4	RU 8201089	L	9	3	3	0	0 0	83
5	RU 8502005	L	6	4	3	3	2 2	78
6	RU 8403006	L	5	1	1	2	2 2	83
7	RU 8401087	L	8	2	2	3	2 2	83
8	RU 8502008	L	7	6	0	2	2 2	76
9	RU 8503009	L	8	5	4	3	2 2	83
10	RU 8301102	L	7	4	4	2	2 2	85
11	RU 8503011	M	4	5	1	0	0 0	80
12	RU 8303181	L	7	4	4	3	2 2	85
13	TEBONNET	L	7	2	5	2	2 2	87
14	BOND	L	8	2	4	1	3 1	83
15	SKYBONNET	L	9	5	3	3	2 2	90
16	LABELLE	L	8	1	7	2	2 2	83
17	CICA4	L	3	0	0	3	3 3	96
18	CICA8	L	3	0	0	1	1 1	82
19	GUI-CHOW	M	9	0	0	2	3 3	90
20	COSTA RICA 1113	L	8	0	1	3	1 3	90
21	RU 8201034	M	6	7	6	0	0 0	87
22	RU 8502022	M	6	5	3	2	2 2	87
23	RU 8503023	L	9	3	6	1	1 1	87
24	RU 8101136	M	2	4	3	2	1 1	85
25	RU 8502025	L	9	2	5	2	2 2	90
26	RU 8403144	L	9	3	4	1	1 1	90
27	RU 8301142	M	4	7	5	0	0 0	87
28	RU 8502028	L	9	3	7	1	2 2	87
29	RU 8403029	L	3	7	6	1	1 1	87
30	RU 8201151	M	3	6	1	3	2 2	87
31	RU 8502031	L	8	7	7	8	1 1	87
32	RU 8303169	L	9	2	4	2	1 1	87

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth _a / blgt-	Leaf _b / smut-	Nar _c / br sp-	Brown Spot _d / Ho-N	Ho-S	Days to heading _e -
33	MARS	M	5	6	4	0	0	90
34	PECOS	M	4	5	0	3	1	83
35	LEAH	L	5	5	4	0	0	90
36	LEBONNET	L	9	7	5	0	0	90
37	BONNETS	L	5	3	5	0	0	93
38	9902 SELN.	L	4	7	3	0	0	96
39	TADUCAN	L	3	2	2	3	3	107
40	TETEP	L	3	1	1	1	1	100
41	RU 8501041	L	6	5	5	0	0	93
42	RU 8502042	L	9	6	4	0	0	87
43	RU 8403043	L	9	6	7	0	0	90
44	RU 8401124	L	5	4	3	0	0	93
45	RU 8502045	L	9	5	6	0	0	91
46	RU 8303046	L	8	7	9	0	0	87
47	RU 8401130	L	5	5	2	3	3	93
48	RU 8502048	L	9	4	8	0	0	87
49	RU 8503049	L	9	4	5	0	0	90
50	RU 8101181	L	7	3	4	0	0	93
51	RU 8502051	L	8	8	7	0	0	90
52	RU 8503052	L	9	2	5	1	1	90
53	TORO-2	L	6	6	3	0	0	91
54	NEWBONNET	L	8	5	1	0	0	91
55	LEMONT	L	7	6	4	0	0	91
56	BELMONT	L	9	5	4	3	3	87
57	RA73 SELN.	L	6	5	2	0	0	93
58	RA73/LBNT	L	5	5	1	0	0	96
59	IR36	L	4	1	0	4	3	91
60	BP87/9902	L	9	4	3	1	1	87
61	RU 8501061	L	5	6	1	1	1	98
62	RU 8502062	L	9	7	5	3	3	90
63	RU 8503063	L	5	4	2	1	1	90
64	RU 8501064	L	6	6	4	0	0	93

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth blgt _a	Leaf smut _b	Nar br sp _c	Brown Spot _d			Days to heading _e
						Ho	Ho-N	Ho-S	
65	RU 8502065	L	9	6	4	0	0	0	90
66	RU 8503066	L	7	3	5	0	0	0	90
67	RU 8201193	L	3	4	1	2	1	2	90
68	RU 8502068	L	6	3	4	0	0	0	90
69	RU 8503069	L	6	2	3	0	0	0	90
70	RU 8301170	L	6	6	4	0	0	0	93
71	RU 8502071	L	6	8	4	0	0	0	93
72	RU 8203141	M	4	7	3	0	0	0	90
73	RU 8501073	L	7	5	3	0	0	0	93
74	RU 8502074	L	6	8	4	0	0	0	96
75	RU 8503075	L	8	3	4	1	1	1	90
76	STARBONNET	L	5	6	2	0	0	0	100
77	BLUEBELLE	L	8	3	5	2	2	2	91
78	CICA6	L	3	1	0	3	2	3	76
79	CICA9	L	3	0	1	3	3	3	105
80	NWRX/BLMT	L	8	6	3	1	1	1	80
81	RU 8401081	L	8	5	1	1	1	1	83
82	RU 8502082	M	8	5	5	3	3	2	83
83	RU 8203085	M	7	7	6	1	3	1	73
84	RU 8501084	L	9	7	3	2	3	1	85
85	RU 8502085	L	6	2	1	3	3	3	83
86	RU 8503086	L	8	7	3	2	3	2	83
87	RU 8501087	L	4	4	1	3	3	3	90
88	RU 8502088	L	4	4	1	1	1	1	80
89	RU 8303089	L	9	7	5	3	3	3	85
90	RU 8501090	L	9	5	3	0	0	0	83
91	RU 8502091	L	9	8	1	0	0	0	83
92	RU 8503092	L	8	2	5	1	1	1	83
93	RU 8201101	M	5	7	0	3	4	2	83
94	RU 8402094	M	5	5	0	0	0	0	80
95	RU 8203129	L	8	4	2	0	0	0	90
96	RU 8501096	L	9	3	2	3	3	3	91

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth _a / blgt	Leaf _b / smut	Nar _c / br sp	Brown Spot		Days to heading
						Ho	d/ Ho-N Ho-S	
97	RU 8502097	L	7	6	3	0	0	85
98	RU 8303098	L	9	7	5	1	1	85
99	RU 8301099	L	5	2	4	1	1	83
100	RU 8502100	M	4	5	0	1	1	78
101	RU 8303101	L	9	1	1	3	3	87
102	RU 8501102	L	8	4	0	1	3	83
103	RU 8502103	M	4	4	1	3	1	80
104	RU 8303006	L	8	5	3	2	2	85
105	RU 8301108	M	4	7	0	1	1	80
106	RU 8502106		4	6	2	0	0	80
107	RU 8503107	L	7	6	1	4	3	76
108	RU 8501108	L	6	4	1	2	1	85
109	RU 8502109		2	7	5	2	2	76
110	RU 8503110	L	7	5	0	3	1	76
111	RU 8401111	L	8	4	2	3	1	83
112	RU 8502112	L	6	5	4	0	0	83
113	RU 8503113	L	9	3	0	2	1	80
114	RU 8501114	L	8	5	0	2	2	83
115	RU 8402115	M	3	7	0	0	0	83
116	RU 8303116	L	4	3	1	1	1	87
117	RU 9980	M	4	5	0	0	0	76
118	RU 8201119	M	3	1	0	0	0	85
119	RU 483097	M	7	1	0	1	1	83
120	RU 9974	M	4	4	0	0	0	80
121	RU 8501121		5	2	3	0	0	90
122	RU 8402025	M	4	5	1	3	3	90
123	RU 8403123	L	2	1	0	3	2	83
124	RU 8501124	L	9	5	3	0	0	87
125	RU 8502125	M	6	7	0	2	1	85
126	RU 8403126	L	5	4	0	0	0	85
127	RU 8501127	L	4	4	3	0	0	87
128	RU 8502128	L	8	8	4	0	0	87
129	RU 8203035	L	6	7	4	1	1	85

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth a/ blgt--	Leaf b/ smut--	Nar c/ br sp--	Brown Spot--		d/ Ho-S	Days to e/ heading--
						Ho	Ho-N		
130	RU 8501130	L	7	6	4	0	0	0	87
131	RU 8502131	L	9	8	3	0	0	0	87
132	RU 8503132	L	7	3	3	2	1	2	90
133	RU 8501133	L	9	5	2	0	0	0	87
134	RU 8502134	L	5	5	3	1	1	1	91
135	RU 8503135	L	5	3	5	1	1	1	90
136	RU 8501136	L	8	5	5	3	3	3	85
137	RU 8502137	L	7	6	5	1	1	1	85
138	RU 8503138	L	7	3	4	0	0	0	87
139	RU 8501139	L	7	6	2	0	0	0	90
140	RU 8502140	L	9	5	4	3	1	3	87
141	RU 8503141	L	9	5	0	0	0	0	85
142	RU 8501142	L	5	5	2	1	1	1	87
143	RU 8502143	L	8	3	4	0	0	0	90
144	RU 8503144	L	5	2	0	0	0	0	83
145	RU 8401145	L	7	5	3	0	0	0	87
146	RU 8502146	L	8	5	5	1	1	1	87
147	RU 8403147	L	6	5	3	0	0	0	90
148	RU 8501148	L	7	6	4	2	2	2	90
149	RU 8502149	L	5	4	1	3	3	3	85
150	RU 8503150	L	9	2	5	1	2	1	85
151	RU 8501151	M	3	8	4	0	0	0	85
152	RU 8502152	L	5	3	5	0	0	0	87
153	RU 8503153	L	6	4	0	3	3	2	78
154	RU 8501154	M	9	5	3	0	0	0	85
155	RU 8502155	L	4	4	1	0	0	0	87
156	RU 8503156	L	7	1	0	0	0	0	78
157	NATO	M	8	5	3	0	0	0	87
158	NEWREX	L	7	6	0	3	3	3	85
159	SATURN	M	7	4	2	2	3	2	85
160	BRAZOS	M	5	4	0	0	0	0	85
161	RU 8501161	L	4	6	1	0	0	0	91
162	RU 8302048	L	4	6	1	0	0	0	90

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth a/ blgt	Leaf b/ smut	Nar c/ br sp	Brown Spot		d/ Ho-S	Days to heading
						Ho	Ho-N		
163	RU 8403163	L	4	2	0	2	2	2	85
164	RU 8401164	L	4	7	1	0	0	0	93
165	RU 8402074	L	5	3	1	0	0	0	93
166	RU 8203135	L	4	6	2	0	0	0	90
167	RU 8401167	L	4	7	4	0	0	0	91
168	RU 8502168	L	8	7	4	1	1	1	90
169	RU 8503169	L	7	4	3	2	2	2	85
170	RU 8501170	L	5	1	1	1	1	1	90
171	RU 8502171	L	6	4	0	1	1	1	90
172	RU 8403172	L	7	4	3	0	0	0	90
173	RU 8501173	L	5	7	1	0	0	0	93
174	RU 8502174	L	9	1	4	0	0	0	90
175	RU 8503175	L	6	2	3	0	0	0	87
176	RU 8501176	L	5	5	3	0	0	0	96
177	RU 8502177	L	8	3	5	0	0	0	93
178	RU 8503178	L	4	1	0	0	0	0	85
179	RU 8301179	M	4	7	5	0	0	0	90
180	RU 8502180	L	7	4	4	0	0	0	87
181	RU 8503181	L	6	6	5	0	0	0	83
182	RU 8301182	M	5	4	2	0	0	0	85
183	RU 8502183	L	7	6	6	0	0	0	87
184	RU 8503184	L	9	5	4	0	0	0	90
185	RU 8501185	L	4	4	4	0	0	0	91
186	RU 8502186	L	5	3	1	3	3	3	87
187	RU 8503187	L	7	4	4	2	2	2	83
188	RU 8501188	L	9	4	2	0	0	0	87
189	DELLA	L	4	5	3	2	2	2	87
190	RU 8503190	L	6	5	3	5	5	4	80
191	RU 8301191	M	7	4	0	0	0	0	85
192	RU 8502192	M	3	4	2	3	3	3	91
193	RU 8503193	L	8	5	3	2	2	2	80
194	RU 8501194	L	9	4	5	3	4	2	83
195	RU 8502195	M	3	3	2	3	3	3	76

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth blgt- a/	Leaf smut- b/	Nar c/ br sp-	Brown Spot-		Days to e/ heading-
						Ho	Ho-N	
196	RU 8503196	L	8	4	0	3	3	2
197	RU 8501197	L	6	3	2	0	0	0
198	BONNET 73	L	6	4	3	0	0	0
199	GUI-CHOW	M	4	0	0	2	2	2
200	NORTI	S	4	5	3	0	0	0
201	ARK ENTRIES	L	5	3	2	1	1	1
202	"	L	6	1	3	0	0	0
203	"	L	8	6	5	0	0	0
204	"	L	9	5	4	0	0	0
205	"	M	7	6	4	0	0	0
206	"	L	8	3	0	3	3	3
207	"	L	5	3	0	2	2	2
208	"	L	5	4	0	3	3	3
209	"	L	9	2	5	0	0	0
210	"	L	9	4	4	2	3	1
211	"	L	9	4	4	1	1	1
212	"	L	9	4	2	1	1	1
213	"	L	9	6	4	0	0	0
214	"	L	7	6	3	0	0	0
215	"	L	9	6	3	0	0	0
216	"	L	5	5	4	1	1	1
217	"	L	8	5	2	0	0	0
218	"	L	5	3	0	0	0	0
219	"	L	8	1	4	0	0	0
220	"	M	6	5	3	0	0	0
221	"	M	5	4	1	2	2	2
222	"	L	6	6	5	1	1	1
223	"	L	8	4	3	0	0	0
224	"	L	5	4	0	3	3	3
225	"	L	5	8	3	0	0	0
226	"	L	5	4	3	3	3	3
227	"	S	4	4	3	0	0	0
228	"	L	8	3	3	1	1	1

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth blgt _a /	Leaf smut _b /	Nar c/ br sp _c	Brown Spot _d /			Days to heading _e
						Ho	Ho-N	Ho-S	
229	ARK ENTRIES	L	5	5	3	1	1	1	93
230	"	L	6	7	2	0	0	0	96
231	"	L	7	5	3	0	0	0	96
232	"	L	5	2	4	0	0	0	93
233	"	L	6	5	2	1	1	1	93
234	"	L	6	5	3	0	0	0	96
235	"	L	7	6	3	0	0	0	91
236	"	L	6	1	1	0	0	0	90
237	"	L	5	4	1	1	1	1	85
238	"	L	9	5	0	1	1	1	85
239	"	L	5	4	2	3	3	2	85
240	"	L	8	3	0	2	4	1	83
241	"	M	8	3	4	1	1	1	87
242	"	L	4	5	4	0	0	0	76
243	"	L	7	3	1	3	3	2	83
244	"	L	8	3	4	0	0	0	83
245	"	L	8	6	4	0	0	0	90
246	"	L	8	1	4	3	3	2	83
247	"	L	9	4	4	2	3	1	83
248	"	L	4	1	0	0	0	0	76
249	"	L	9	7	5	0	0	0	90
250	"	L	8	6	5	1	1	1	90
251	"	L	7	4	3	2	2	2	78
252	"	L	6	2	0	3	3	3	83
253	"	L	9	3	4	0	0	0	91
254	"	L	5	4	4	0	0	0	90
255	"	L	6	6	2	0	0	0	90
256	"	L	7	3	3	0	0	0	90
257	"	L	8	6	4	0	0	0	91
258	"	L	8	3	2	3	4	3	85
259	"	L	7	2	0	1	2	1	80
260	"	L	9	7	4	0	0	0	90
261	"	L	7	4	4	2	3	1	85

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth _a / blgt	Leaf _b / smut	Nar c/ br sp	Brown Spot			Days to e/ heading
						Ho	Ho-N	Spot _d / Ho-S	
262	ARK ENTRIES	L	9	5	4	0	0	0	90
263	"	L	7	3	4	1	1	1	87
264	"	L	8	6	4	0	0	0	90
265	"	L	7	4	3	1	1	1	85
266	"	M	6	6	4	0	0	0	90
267	"	L	9	5	4	1	1	1	90
268	"	L	9	5	4	0	0	0	90
269	"	L	5	5	0	0	0	0	98
270	"	L	7	4	3	0	0	0	91
271	"	L	9	6	4	0	0	0	91
272	"	L	6	4	4	1	1	1	90
273	"	L	5	0	0	1	1	1	93
274	"	L	8	7	6	0	0	0	90
275	"	L	6	4	1	3	3	1	90
276	"	L	4	6	2	0	0	0	98
277	"	L	5	4	1	3	1	3	91
278	"	L	5	5	3	1	1	1	91
279	"	M	6	4	2	0	0	0	90
280	"	L	9	4	5	0	0	0	87
281	"	L	5	4	3	0	0	0	90
282	"	L	2	1	0	0	0	0	76
283	"	M	4	1	0	0	0	0	76
284	"	M	5	0	0	3	3	3	90
285	"	L	4	3	1	0	0	0	96
286	"	L	9	3	5	0	0	0	90
287	"	L	8	4	4	0	0	0	91
288	"	L	4	3	1	1	1	1	96
289	"	L	5	4	1	0	0	0	96
290	"	L	6	2	1	3	3	2	98
291	"	L	4	3	2	0	0	0	93
292	"	L	8	4	5	0	0	0	91
293	"	L	4	3	1	3	1	3	96
294	"	L	7	2	3	0	0	0	93

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth blgt ^a /	Leaf _b / smut ⁻	Nar c/ br sp ⁻	Brown Spot ^d / Ho Ho-N Ho-S	Days to e/ heading ⁻
295	ARK ENTRIES	L	6	2	1	0	91
296	"	L	6	3	1	0	90
297	"	L	5	4	1	3	90
298	"	L	4	3	1	3	93
299	"	L	4	5	1	1	93
300	"	L	7	2	3	0	91
301	TX3795	L	6	4	0	3	76
302	TX3691	L	8	1	0	3	76
303	TX3703	L	8	1	0	1	76
304	TX3589	L	6	4	0	1	83
305	TX3745	L	4	3	0	1	80
306	TX12679	L	7	3	0	2	78
307	TX3579	L	7	3	0	0	76
308	TX972	L	5	2	0	1	80
309	TX11450-52	L	6	6	3	3	78
310	TX11295-99	L	5	2	2	0	83
311	TX11537-41	L	9	1	2	3	80
312	TX3739	L	8	5	0	4	83
313	TX12232-35	L	6	3	2	4	76
314	TX12755	L	8	5	4	3	78
315	TX12591	L	9	5	0	3	76
316	TX12589-90	L	8	1	3	2	80
317	TX12545-46	L	6	4	4	3	80
318	TX13539	L	9	2	2	2	78
319	TX13334-36	L	6	3	0	1	76
320	TX12607-10	L	5	1	1	1	83
321	TX12274-78	L	7	1	0	1	78
322	TX11779	L	5	2	0	1	83
323	TX11429-33	L	5	3	0	3	83
324	TX11398-400	L	9	3	0	1	80
325	TX15838-40	L	8	3	3	2	83
326	TX8751-55	L	9	3	2	2	83
327	TX11962-65	L	5	3	0	0	83

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth blgt- a/	Leaf smut- b/	Nar c/ br sp-	Brown Spot- d/		Days to e/ heading-
						Ho	Ho-N	Ho-S
328	TX11352-56	L	5	3	2	0	0	0
329	TX11310-14	L	7	6	3	1	1	1
330	TX8751-55	L	7	5	4	1	1	1
331	TX13116	L	5	3	0	2	2	1
332	TX938	L	7	2	1	1	1	1
333	TX1223	L	8	3	1	2	2	2
334	TX1233	L	6	4	0	1	1	1
335	TX11885-86	L	6	4	4	3	3	3
336	TX15997	L	5	2	2	1	1	1
337	TX11331-34	L	5	3	2	0	0	0
338	TX324	L	7	2	0	3	3	2
339	TX10953-57	L	7	1	2	3	3	2
340	TX8719-21	L	6	3	2	2	2	2
341	TX7744-47	L	7	3	3	0	0	0
342	TX13629	L	4	2	0	2	2	2
343	TX13654	L	8	5	0	2	2	2
344	TX11523-25	L	7	4	0	3	2	4
345	TX10561-65	L	7	4	0	0	0	0
346	TX13844-48	L	7	4	0	2	2	2
347	TX11501-03	L	6	5	3	0	0	0
348	TX12206-08	L	7	6	0	3	3	3
349	TX12514-16	L	6	3	0	2	3	1
350	TX12706-08	L	7	3	0	3	3	2
351	TX7033-37	L	8	1	3	0	0	0
352	TX8659-62	L	6	1	3	3	3	3
353	TX8656-57	L	6	3	3	1	2	1
354	TX12279-83	L	7	4	0	3	3	3
355	TX13583-85	L	3	1	0	3	3	3
356	TXHR	L	7	3	0	1	2	1
357	TX8732-34	L	6	2	1	1	1	2
358	TX13112-13	L	6	1	0	1	1	1
359	TX6889-93	L	6	2	2	3	4	2
360	TX7110-14	L	7	2	5	2	2	2

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth _a / blgt	Leaf _b / smut	Nar c/ br sp	Brown Spot _d /			Days to e/ heading
						Ho	Ho-N	Ho-S	
361	TX7615-19	L	6	3	2	3	2	3	85
362	TX7668-72	L	6	1	2	2	2	2	87
363	TX7038-42	L	7	4	4	2	2	2	83
364	TX13423-24	L	6	4	3	2	3	2	85
365	TX7239-43	L	7	1	3	0	0	0	87
366	TX7363-67	L	7	1	2	0	0	0	90
367	TX7505-06	L	8	4	5	1	1	2	87
368	TX8689-91	L	6	4	4	1	2	1	85
369	TX9459-63	L	6	3	3	2	2	2	85
370	TX530	L	5	7	0	1	2	1	83
371	TX12258-62	L	6	3	3	1	2	1	85
372	TX7790-92	L	7	1	5	1	1	1	90
373	TX7976-78	L	8	3	4	1	1	1	87
374	TX1229	L	6	2	1	0	0	0	90
375	TX9407-11	L	5	2	0	2	3	1	85
376	TX8748-49	L	5	2	2	1	2	1	85
377	TX10891-95	L	8	2	3	3	3	3	87
378	TX8624		8	2	6	2	2	2	85
379	TX8709-10	L	6	1	5	0	0	0	87
380	TX7199-7202	L	8	3	4	1	1	1	90
381	TX2837	L	7	6	2	2	3	2	83
382	TX8665-67	L	6	3	4	0	0	0	87
383	TX919	L	9	3	2	0	0	0	87
384	TX2725	L	8	3	2	0	0	0	87
385	TX2870	L	8	8	5	1	2	1	83
386	TX7897-98	L	8	2	3	0	0	0	87
387	TX2711	L	7	3	4	0	0	0	87
388	TX2746	L	5	3	5	0	0	0	90
389	TX2891	L	8	3	7	0	0	0	90
390	TX2962-63	L	7	3	3	0	0	0	85
391	TX919	L	7	2	1	1	1	1	91
392	TX2732	L	7	1	2	0	0	0	87
393	TX10219-23	L	6	2	2	0	0	0	90

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth blgt-	Leaf a/ smut-	Leaf b/ smut-	Nar c/ br sp-	Brown Spot-		Days to e/ heading-
							Ho	Ho-N	d/ Ho-S
394	TX917	L	7	3	3	1	1	1	90
395	TX2787	L	7	3	3	2	0	0	90
396	TX9368-70	L	8	2	2	2	1	1	90
397	TX2694	L	6	4	1	1	0	0	90
398	TX2743	L	9	3	4	4	0	0	91
399	TX2942	L	9	3	1	1	0	0	90
400	TX15750	L	6	1	1	1	0	0	90
401	LA8502501	L	9	3	0	0	1	1	83
402	LA8502502	L	9	7	5	5	1	1	80
403	LA8502506	L	7	4	7	7	0	0	76
404	LA8502508	L	8	3	7	7	0	0	83
405	LA8502509	L	7	1	8	8	0	0	80
406	LA8502510	L	8	3	7	7	2	2	80
407	LA8502511	L	7	2	4	4	1	1	83
408	LA8502512	L	9	2	8	8	0	0	80
409	LA8502513	L	9	1	9	9	0	0	80
410	LA8502514	L	8	3	7	7	0	0	83
411	LA8502515	L	8	8	4	4	1	1	83
412	LA8502518	L	8	1	6	6	0	0	76
413	LA8502519	L	7	3	3	3	1	1	76
414	LA8502520	L	7	4	6	6	0	0	83
415	LA8502521	L	9	3	4	4	0	0	80
416	LA8502524	L	8	3	6	6	0	0	83
417	LA8502525	L	7	2	4	4	1	3	83
418	LA8502526	L	9	7	2	2	0	0	83
419	LA8502527	L	8	4	4	4	0	0	87
420	LA8502528	L	9	1	5	5	1	1	83
421	LA8502533	L	5	1	1	1	4	2	83
422	LA8502535	L	6	2	3	3	1	1	80
423	LA8502540	L	8	2	4	4	0	0	83
424	LA8502541	L	8	3	5	5	0	0	83
425	LA8502544	L	9	1	6	6	0	0	83
426	LA8502545	L	9	1	2	2	1	1	80

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth blgt--a/	Leaf smut--b/	Nar c/ br sp--	Brown Spot--d/ Ho Ho-N Ho-S	Days to heading--e/
427	LA8502546	L	9	2	6	0 0 0	83
428	LA8502547	L	9	2	6	0 0 0	80
429	LA8502548	L	8	2	4	0 0 0	83
430	LA8502549	L	9	0	5	0 0 0	87
431	LA8502551	L	9	1	6	0 0 0	90
432	LA8502553	L	7	1	3	1 2 1	83
433	LA8502557	L	7	1	2	2 2 1	83
434	LA8502558	L	8	3	2	2 2 1	91
435	LA8502563	L	5	4	1	1 1 1	83
436	LA8502564	L	3	4	1	1 1 1	90
437	LA8502565	L	5	2	1	0 0 0	83
438	LA8502568	L	5	3	2	0 0 0	90
439	LA8502569	L	7	3	4	0 0 0	90
440	LA8502570	L	6	2	2	0 0 0	90
441	LA8502571	L	5	1	2	1 2 2	90
442	LA8502573	L	9	4	5	0 0 0	83
443	LA8502575	L	7	4	3	1 1 1	90
444	LA8502577	L	7	2	3	1 2 1	83
445	LA8502578	L	7	2	4	1 1 1	87
446	LA8502579	L	6	7	1	0 0 0	83
447	LA8502580	L	9	1	4	0 0 0	83
448	LA8502581	L	7	3	2	1 2 1	87
449	LA8502582	L	7	3	4	0 0 0	90
450	LA8502583	L	9	1	6	0 0 0	83
451	LA8502584	L	9	1	6	1 2 1	85
452	LA8502586	L	9	1	5	1 2 2	85
453	LA8502587	L	9	1	7	0 0 0	87
454	LA8502588	L	9	1	5	0 0 0	87
455	LA8502589	L	9	3	6	0 0 0	90
456	LA8502590	L	8	1	5	0 0 0	85
457	LA8502591	L	5	4	2	2 2 2	83
458	LA8502592	L	8	1	7	0 0 0	87
459	LA8502593	L	5	4	1	2 2 1	87

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth a/ blgt	Leaf b/ smut	Nar c/ br sp	Brown Spot		Days to e/ heading
						Ho	Spot- Ho-N Ho-S	
460	LA8502594	L	4	4	3	1	1	90
461	LA8502596	L	4	5	1	0	0	85
462	LA8502597	L	4	3	6	0	0	87
463	LA8502599		9	2	7	0	0	90
464	LA8502600	L	6	2	5	1	1	90
465	LA8502601	L	9	1	8	0	0	76
466	LA8502602	L	8	0	4	1	1	90
467	LA8502603	L	8	1	5	0	0	90
468	LA8502604	L	9	1	4	1	1	85
469	LA8502606	L	8	5	2	0	0	91
470	LA8502608	L	8	6	4	0	0	87
471	LA8502610	L	9	2	6	1	1	87
472	LA8502612	L	8	3	4	0	0	87
473	LA8502613	L	8	3	3	1	1	90
474	LA8502614	L	9	2	2	2	2	87
475	LA8502615	L	9	2	3	1	1	87
476	LA8502616	L	6	7	3	0	0	83
477	LA8502618	L	7	1	4	0	0	90
478	LA8502619	L	6	2	5	0	0	90
479	LA8502620	L	5	3	3	0	0	90
480	LA8502621	L	9	2	4	1	1	87
481	LA8502622	L	9	7	5	0	0	85
482	LA8502623	L	9	4	5	0	0	87
483	LA8502624	L	9	5	2	0	0	87
484	LA8502625	L	9	1	4	0	0	87
485	LA8502626	L	5	3	4	0	0	90
486	LA8502629	L	6	4	6	0	0	87
487	LA8502630	L	7	1	4	0	0	87
488	LA8502635	L	6	3	2	3	3	83
489	LA8502636	L	6	4	3	0	0	87
490	LA8502641	L	6	3	3	0	0	90
491	LA8502642	L	8	6	4	1	1	91
492	LA8502643	L	7	2	5	3	3	83

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth _a / blgt	Leaf _b / smut	Nar c/ br sp	Brown Spot _d		Days to heading _e
						Ho	Ho-N	Ho-S
493	LA8502644	L	6	2	5	0	0	0
494	LA8502645	L	6	5	3	0	0	90
495	LA8502646	L	7	7	4	0	0	90
496	LA8502647	L	5	4	3	0	0	85
497	LA8502648	L	5	6	3	0	0	91
498	LA8502649	L	5	5	3	0	0	90
499	LA8502650	L	6	7	2	0	0	90
500	LA8502652	L	5	4	3	0	0	91
501	BELLEVUE	L	4	8	5	0	0	93
502	84A52055	L	9	3	3	0	0	78
503	85A52056	L	9	3	6	0	0	76
504	83(456)	M	6	5	4	3	3	90
505	83(501-2)	L	7	1	3	2	3	76
506	83(503-2)	L	9	2	4	0	0	73
507	83(504-1)	L	9	4	2	0	0	73
508	83-3633	L	9	1	1	0	0	80
509	83A53053	M	7	6	1	0	0	83
510	85A53057	M	6	3	1	0	0	83
511	85A53058	M	4	6	2	0	0	83
512	82-5527	M	7	5	3	3	3	83
513	82-5491	M	9	7	3	0	0	87
514	84-204(112)	M	4	5	2	3	3	90
515	83-4109	M	7	2	1	3	3	90
516	LA ENTRIES	L	4	1	0	3	3	91
517	"	L	6	4	3	0	0	91
518	"	L	4	1	0	4	5	93
519	"	L	9	3	4	3	3	87
520	"	L	8	4	5	0	0	90
521	"	L	9	4	6	0	0	87
522	"	L	9	6	4	0	0	87
523	"	L	8	4	6	1	1	90
524	"	L	8	3	5	0	0	90
525	"	L	6	1	1	5	4	87

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth _a / blgt	Leaf _b / smut	Nar c/ br sp	Brown Spot _d / Ho-N	Ho-S	Days to e/ heading
526	LA ENTRIES	L	6	1	3	0	0	90
527	"	L	6	1	1	5	4	83
528	"	L	9	6	1	0	0	90
529	"	L	2	1	0	6	1	90
530	"	L	7	5	7	2	2	87
531	"	L	6	6	7	3	2	90
532	"	L	3	1	0	6	1	90
533	"	L	8	2	5	2	2	78
534	"	L	5	1	5	4	4	83
535	"	L	7	8	6	3	3	83
536	"	L	4	7	4	2	4	83
537	"	L	7	3	5	3	2	78
538	"	M	4	7	3	3	3	83
539	"	M	6	6	7	2	5	83
540	"	M	4	8	4	3	1	83
541	"	M	5	7	4	2	3	83
542	"	M	5	7	5	2	3	78
543	"	M	5	7	6	3	3	83
544	"	M	4	8	7	2	1	83
545	"	M	6	8	6	1	1	83
546	"	M	4	8	4	0	0	85
547	"	M	5	4	4	0	0	80
548	"	M	4	6	4	3	5	83
549	"	M	6	9	1	3	3	83
550	"	S	5	5	3	2	4	90
551	"	M	2	8	0	2	5	91
552	"	M	3	7	0	2	2	91
553	"	M	5	6	0	2	4	91
554	"	M	6	7	3	2	2	80
555	"	M	6	1	5	0	0	87
556	REG. MARS	M	3	7	7	2	2	87
557	"	M	4	8	7	0	0	87
558	"	M	4	7	5	0	0	85

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth blgt-a/	Leaf smut-b/	Nar c/ br sp-	Brown Spot-d/			Days to heading-e/
						Ho	Ho-N	Ho-S	
559	REG. MARS	M	5	7	7	0	0	0	87
560	"	M	5	5	7	3	3	3	85
561	"	M	7	5	4	2	1	3	87
562	83T1020		3	6	0	0	0	0	91
563	"	M	2	8	0	1	1	3	91
564	"		2	8	0	2	1	4	91
565	"		3	6	0	3	2	3	91
566	83T1024	L	8	1	0	4	4	3	76
567	REG. MARS	M	6	2	6	3	3	3	87
568	"	M	5	8	5	4	1	6	90
569	"	M	4	5	5	0	0	0	87
570	REG. BLMT	L	8	2	7	3	3	3	83
571	"	L	8	4	8	3	3	3	83
572	"	L	8	2	9	2	2	2	83
573	REG. BRAZOS	M	6	7	3	2	1	3	83
574	"	M	3	6	0	2	1	2	83
575	"	M	5	4	0	3	2	3	83
576	REG. LBNT-A	L	8	7	5	1	1	2	90
577	"	L	8	6	7	2	2	2	90
578	"	L	8	3	7	2	2	2	85
579	REG. LBNT-B	L	8	3	8	2	2	2	87
580	"	L	9	3	7	3	1	3	87
581	"	L	9	7	7	2	2	2	87
582	REG. STRN-A	M	9	7	7	2	2	2	83
583	"	M	9	1	7	3	5	1	83
584	"	M	8	4	8	2	1	3	83
585	REG. STRN-B	M	8	6	0	2	6	0	83
586	"	M	6	1	8	2	2	2	85
587	"	M	8	1	7	2	2	2	83
588	REG. STRN-C	M	8	1	8	2	2	2	83
589	"	M	9	1	7	3	3	3	83
590	"	M	8	0	7	2	2	2	83
591	WCC 353635	M	7	0	0	6	5	7	80

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth _a / blgt	Leaf _b / smut	Nar _c / br sp	Brown Spot _d		Days to e/ heading
						Ho	Ho-N	
592	WCC 353665	M	7	0	0	6	6	80
593	WCC 350556	M	5	2	2	3	3	107
594	WCC 350552	M	6	2	2	3	4	107
595	WCC 353631	M	-	-	-	-	-	80
596	WCC 343030	M	3	2	3	4	5	83
597	WCC 81-2000	M	4	2	0	3	3	80
598	WCC 338120	L	4	8	1	0	0	98
599	WCC 81-1985	M	7	1	2	8	8	76
600	WCC 343837	M	7	3	8	3	3	76
601	POKKALI	M	2	0	0	4	1	81
602	PI-403303 DV-114		-	-	-	-	-	76
603	PI-403232 DNS-1550		-	-	-	-	-	76
604	PI-221109 BJ-1		-	-	-	-	-	83
605	PI-2277247 TAINAN 1T	M	7	6	4	0	0	73
606	MASHURI	M	4	1	1	3	3	131
607	MINIHIKAI	M	4	4	3	0	0	87
608	GUANGLUA14	M	7	0	0	7	7	76
609	BR-IRGA-409	L	3	2	0	6	5	90
610	TAIPEI 309	M	7	7	4	3	7	90
611	YOKE	M	6	0	0	3	4	83
612	PI-224903 SHIMO-TAUKI	M	2	3	1	2	3	98
613	PI-388999 SHIRANUI	M	4	3	0	3	3	98
614	PI-442982 BPI-76	M	4	0	0	2	8	103
615	PI-365204 PANKAJO	M	3	0	0	5	4	147
616	PI-403054 DF-1	M	4	0	0	6	7	76
617	PI-277235 TAICHUNG 122X	M	3	7	3	3	3	83
618	PI-385764 MUSHKEN 70	M	5	1	4	3	3	119
619	PI-224932 WASE-AIKIKV3	S	4	6	6	2	3	76
620	PI-388457 GIMBOZOT	M	7	5	7	3	3	83
621	11-388587 FUJIMINORIX	M	5	8	4	3	4	76
622	PI-351106 PANKHARI 203X	M	3	1	0	2	2	147
623	QUING QUN WANG	M	5	1	0	4	4	73
624	IR-36		3	2	0	5	6	85

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth _a /blgt	Leaf _b /smut	Nar c/ br sp	Brown Spot ^d		Days to e/ heading
						Ho	Ho-N	Ho-S
625	PI-329236 DEE-GEO-WOO-GEN	M	2	0	0	4	5	2
626	PI-353441 BASMATI 370	M	3	0	0	3	3	3
627	PI-201900 N-12	M	3	0	0	3	3	3
628	PI-403186 DNJ-27	M	3	0	0	0	0	0
629	PI-201841 SORNAVARI	M	3	0	1	4	3	3
630	PI-402933	M	3	0	1	3	2	3
631	IR1317 (DR. KIM)	M	6	0	0	7	5	8
632	PI-432572	M	6	6	0	3	3	4
633	PI-402887 CHV-TU	M	7	0	0	6	7	3
634	803-16-1-B	L	5	4	0	3	3	3
635	803-16-2	M	4	0	0	6	7	3
636	803-18-2	L	3	1	1	6	7	3
637	LBNT	L	3	5	3	3	3	4
638	803-26-3	L	4	1	0	2	2	3
639	803-29-1		5	0	0	8	9	6
640	803-29-3	M	5	0	0	7	8	3
641	803-31-1	M	2	2	0	5	6	3
642	803-31-2	L	2	2	0	5	3	7
643	803-40-2	L	4	0	0	2	2	2
644	803-41-2	L	3	0	0	6	7	3
645	803-41-3	L	4	0	0	3	3	3
646	803-43-2	L	2	0	0	3	3	3
647	803-43-3	M	4	0	0	6	5	6
648	803-44-2	L	4	0	0	5	4	5
649	803-44-3	M	3	5	7	2	2	7
650	803-45-2	L	3	1	0	6	5	6
651	803-45-3	L	3	3	5	7	7	6
652	803-46-4	L	4	2	0	7	8	6
653	803-50-1	L	4	7	0	3	3	3
654	803-50-4	L	3	1	0	2	2	3
655	803-50-5	L	2	0	0	2	5	1
656	803-50-6	L	5	0	0	4	1	7
657	803-51-1	L	5	0	0	1	2	1

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth blgt _a /	Leaf smut _b /	Nar br sp _c /	Brown Spot _d /		Days to heading _e /
						Ho	Ho-N	
658	803-54-2	L	2	0	0	3	1	5
659	803-54-4	M	3	0	0	3	3	0
660	803-68-1-B	L	3	0	0	2	4	1
661	803-40-1	L	3	0	0	2	2	2
662	803-41-2	L	5	0	0	4	4	5
663	803-41-4	L	4	7	5	1	1	1
664	803-74-1-B	L	3	0	0	3	7	2
665	803-74-2-B	L	2	0	0	3	7	1
666	803-74-3-B	L	5	4	0	2	1	3
667	803-98-2-B	L	6	1	0	5	7	2
668	803-80-1-B	L	3	0	0	4	3	4
669	803-80-3-B	L	3	3	0	2	2	3
670	803-80-6-B	L	2	0	0	2	2	2
671	803-85-5-B	L	3	7	2	3	3	3
672	803-84-1	L	2	1	0	5	4	5
673	803-84-3-B	L	4	7	0	3	7	1
674	803-95-2-B	L	3	3	3	1	1	1
675	803-95-3-B	L	5	0	0	5	4	6
676	803-99-1-B	L	4	8	0	3	3	3
677	803-98-2	L	3	0	0	6	6	4
678	803-102-2-B	L	3	6	2	3	3	3
679	803-102-5-B	M	2	4	0	7	8	4
680	803-114-1-B	L	4	2	0	7	7	3
681	803-118-4-B	L	3	3	3	7	6	8
682	803-118-5	L	4	1	0	7	5	8
683	803-130-6-B	L	2	3	0	6	8	4
684	807-9-4-B	L	2	2	4	3	3	4
685	807-12-4-B	L	2	8	0	0	0	0
686	807-12-5-B	L	3	0	0	4	5	3
687	807-23-1-B	L	2	0	0	1	1	1
688	807-23-4-B	L	2	0	0	1	1	1
689	803-91-5-B	L	4	7	0	2	2	2
690	807-26-2-B	L	2	3	0	3	5	2

CONTINUED.

Table 1. CONTINUED.

Entry No.	Identification number or variety	Grain type	Shth blgt-a/	Leaf b/ smut--	Nar c/ br sp--	Brown Spot--d/		Days to e/ heading--
						Ho	Ho-N	
691	807-27-4-B	L	2	1	0	5	5	3
692	807-45-2-B	L	5	3	0	2	2	2
693	807-45-4-B	L	2	3	0	3	3	3
694	807-45-5-B	L	3	5	0	3	3	4
695	807-45-6-B	L	5	2	0	1	3	1
696	808-147-4-B	L	5	3	0	5	6	3
697	808-148-3-B	L	6	4	0	5	3	6
698	808-148-5-B	L	6	3	5	3	3	3
699	808-151-6-B	L	4	5	2	5	7	3
700	808-159-6	L	4	1	0	4	7	1

a/ Based on a 0 to 9 rating scale with 0 representing no infection and 9 representing severe infection, with most of the tissue of each plant killed by sheath blight.

b/ Based on a 0 to 9 rating scale with 9 representing a very susceptible reaction to leaf smut.

c/ Based on a 0 to 9 rating scale with 9 representing a very susceptible reaction to narrow brown spot.

d/ Based on a 0 to 9 rating for disease rating (Ho), lesion number (Ho-N) and lesion size (Ho-S).

e/ Days to heading is the number of days from planting to 50% emergence of the panicles in a plot.

PLANT INTRODUCTIONS

(A Progress Report)

D.E. Groth, M.J. Frey, and J. Nugent

INTRODUCTION

Plant scientists are continually searching for new germplasm which might be used in attaining the objectives of their breeding or genetics programs. Rice (*Oryza sativa* L.) lines from foreign regions are an important source of these characteristics for rice varietal development and genetic studies. This germplasm can provide new sources of yield potential, disease and insect resistance, other agronomic traits, and genetic markers not available in the national plant germplasm system.

One of the major problems in introducing this material into the USA from other countries is the potential of introducing a new pathogen or insect pest with the seeds. The goal of a plant quarantine is to prevent the introduction of these dangerous new pests into the country. However, small samples of seed can be safely brought through quarantine into the USA for research purposes by using specific precautions and methods. These precautions include quarantine isolation, phytosanitation certificates, heat therapy, inspection of seeds, seed health tests and grow out of the plants.

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°C ± 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.

Germplasm evaluation. The plant introductions from 1984 (1) were planted on April 16, 1985. 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. On April 30, Propanil was applied at 4 lb/A to control weeds. On May 3, 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 nursery were inoculated with a rice seed: rice hull:fungus inoculum at a rate of 50 ml/2 row plot on May 30. 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 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.

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 infection severity on a 0 to 9 scale previously reported (2). Grain type and plant height were recorded for each entry. Disease reactions to naturally occurring brown spot (Bipolaris oryzae), leaf smut (Entyloma oryzae), and narrow brown leaf spot (Cercospora oryzae) were made for each line using 0 to 9 scales (2). Plant height and grain type were recorded for each entry.

RESULTS AND DISCUSSION

Approximately 105 new rice lines were introduced through plant quarantine in 1985 (Table 1). These lines included 48 rice varieties from the People's Republic of China, 11 wild species of rice and 48 breeding lines from the International Rice Research Institute (Manila, Philippines).

Seed of each line will be increased in 1986 and be deposited in the National Small-grains Collection at Beltsville, Maryland where it will be made available some time in 1987. In addition, all lines will be screened for various characteristics including disease resistance, insect resistance, and other agronomic traits.

Table 1. Rice lines and species introduced from foreign countries through quarantine. 1985.

Introduction number	Source ^{a/}	Source identification number ^{b/}	Variety, cross ^{c/} or genus species ^{c/}
850262	P.R.C.		
63	"		Shuan Nong 422
65	"		Luo ham gu
67	"		Shuang Xu gu
68	"		Qing ma Zhan
69	"		Al tuo qu 151
70	"		La Cheag 11
71	"		Quer Zi
72	IRRI		IR18348-36-3-3
73	"		IR18350-229-3
74	"		IR24632-34-2
75	"		IR25588-7-3-1
76	"		IR25621-135-1-1
77	"		IR25840-83-3-2
78	"		IR28128-45-3-3-2
79	"		IR28238-109-1-3-2-2
80	"		IR28239-94-2-3-6-2
81	"		IR29670-15-2-3
82	"		IR29692-9-1-3-2
83	"		IR29692-14-1-1-2
84	"		IR29692-65-2-3-3
85	"		IR29692-94-2-1-3
86	"		IR29708-23-1-2-2
87	"		IR29708-41-2-2-3
88	"		IR29708-113-3-2-3
89	"		IR29725-3-1-3-2
90	"		IR29725-22-3-3-3
91	"		IR31779-112-1-2-2-3
92	"		IR31802-48-2-2
93	"		IR31837-11-2-2-1-2
94	"		IR31851-63-1-2-3-2
95	"		IR31864-64-2-3-3-3
96	"		IR32333-61-2-3-2
97	"		IR32358-39-3-1-1
98	IRRI		IR32358-122-2-1-2
99	"		IR32429-47-3-3-2-2
850300	"		IR32429-115-3-2-6
1	"		IR34631-6-1-3
2	"		IR34631-113-1-2
4	"		IR34681-27-3-3-3
5	"		IR35300-56-2-2-1
6	"		IR35311-96-3-2-1
7	"		IR39368-57-3-2
8	"		IR21820-154-3-2-2-3

CONTINUED.

Table 1. CONTINUED.

Introduction number	Source ^{a/}	Source identification number ^{b/}	Variety, cross ^{c/} or genus species ^{c/}
850309	"		IR21848-65-3-2-2
10	"		IR28153-10-3-1-3
11	"		IR28183-2-2-1-1
12	"		IR28222-23-1-3-3-2
13	"		IR29706-11-1-3-3
14	"		IR31916-17-2-1-2
15	"		IR35353-94-2-1-3
16	"	AC 100968	<u>O. rufipogon</u>
17	"	AC 100179	<u>O. officinalis</u>
18	"	AC 100181	<u>O. officinalis</u>
23	"	AC 100914	<u>O. latifolia</u>
24	"	AC 100947	<u>O. officinalis</u>
25	"	AC 100953	<u>O. officinalis</u>
30	"	AC 101417	<u>O. punctata</u>
31	"	AC 101424	<u>O. eichigeri</u>
35	"	AC 101800	<u>O. glaberrima</u>
36	"	AC 102435	<u>O. glaberrima</u>
37	"	AC 102445	<u>O. glaberrima</u>
38	P.R.C.		Zhong 83-4g
39	"		Zufei 10
40	"		Mei early dwarf 3#
41	"		Green grain drawf 3#
42	"		Mei late 2#
45	"		Guang Lu Ai 4#
46	P.R.C.		Hang 800 4
48	"		Hong 410
49	"		Shuxian 1#
50	"		Hong Tu 5#
51	"		Nan Ter
52	"		Shaono 2#
53	"		Zhou Early Nuo
54	"		R-Jiu Fung
55	"		Yuan Fun Zhao
56	"		Zher Fu 802
57	"		Hu Zheng Zhao
59	"		Shu 10175-2
60	"		Shu 7038
61	"		Jing Fung 8#
62	"		Zhong Zhuo 75#
63	"		Zhong Zhao 9#
64	"		Hui 300
65	"		Ta Du Kang
67	"		Jing Fung 5#
74	"		Dianrey

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CONTINUED.

Table 1. CONTINUED.

Introduction number	Source ^{a/}	Source identification number ^{b/}	Variety, cross, or genus species ^{c/}
850375	P.R.C.		Shuyunuo
76	"		CAAS 44069
77	"		CAAS 44427
78	"		F ₁ Seed
79	"		"
80	"		"
81	"		"
82	"		"
83	"		"
84	"		"
85	"		"
86	"		"
87	"		"
88	"		"
89	"		"

^{a/} Source of rice seed P.R.C. = People's Republic of China,
IRRI = International Rice Research Institute.

^{b/} Identification number given to rice line by originating institute.

^{c/} Specific name, genus species, or cross identification given to line by
originating institute.

The results of the germplasm evaluations are presented in Table 2. Numerous lines showed good resistance to sheath blight, leaf smut, brown spot, and narrow brown spot. Abundant variation was also present in the introduced lines in terms of plant height, heading date, and grain type. Further evaluations will be conducted.

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3. International Seed Testing Association. 1966. International rules for seed testing. Proc. Int. Seed Test. Assoc. 31:1-152.

Table 2. Agronomic and disease resistance traits of 1984 plant introductions tested in 1985 at the Rice Research Station.

Introduction Number	Name or cross	P.I. No.	Height in cm.	Days to heading	Grain type	Sheath blight	Brown spot	Narrow brown	Leaf smut
DG84001	Hunan early Dwf. #2	PI 494756	88	99	M	3	3	0	0
2	Hunan early Dwf. #3	PI 494757	76	63	M	6	2	0	0
3	Hunan early Dwf. #4	PI 494758	76	76	M	5	3	0	0
4	Hunan early Dwf. #7	PI 494759	63	63	M	8	0	0	0
5	Hunan early Dwf. #8	PI 494760	76	64	M	5	3	1	1
6	Hunan early Dwf. #9	PI 494761	86	74	M	5	3	0	0
7	Wan li Xian	PI 503033	117	74	M	3	3	0	0
8	Hunan Sinica #12		92	83	M	3	3	0	0
9	Dong Ting Wan	PI 503034	104	98	M	2	4	0	0
DG84010	Hunan late Indica #2	PI 503035	67	62	M	8	0	0	0
11	Chao Lang (1Hao) #1	PI 503036	74	62	M	7	1	0	0
12	Er Jiu Qing	PI 503037	90	110	M	3	3	0	0
13	Yuan Feng Zao	PI 494765	81	65	M	6	3	0	0
14	Qui Lu Ai (8Hao) #8	PI 494764	77	70	M	5	3	0	0
15	Qing Gan Huang	PI 503038	72	70	M	5	0	0	0
16	Zhen Long 13	PI 503039	77	70	M	5	4	0	0
18	Cha Shan Jing	PI 503040	120	139	M	4	3	1	1
20	Hua Qiu	PI 494763	110	75	M	6	2	0	1
21	Ai Huang Zhong	PI 503041	90	110	M	3	2	0	0
22	Ai Geng 23	PI 503042	93	123	M	4	2	0	0
23	Nong Hong 73	PI 503043	92	112	M	5	2	1	0
24	Nong Hu (6Hao) #6	PI 503044	98	112	M	3	3	1	0
25	Jing Keng 19	PI 503045	88	110	M	3	0	1	3
26	Shuang Ai Nuo	PI 503046	104	101	M	3	3	6	0
27	Wa Zui Nuo	PI 503047	129	140	M	2	2	0	0
28	Las Hu Dao	PI 503048	132	131	M	3	1	0	0
29	Tai Hu Qing	PI 503049	126	124	M	4	0	0	0
30	Ai Du Zhong	PI 503050	125	128	M	3	2	0	0
DG84161	Cica 7//5461/4414	PI 503051	103	124	L	3	3	0	1
162	Cica 7//IR36/4422	PI 503052	87	100	L	4	5	1	0
163	13G90-2//K8/Bahagia	PI 503053	92	128	L	2	5	0	0
164	4440//BG90-2/SML5617	PI 503054	98	107	L	5	4	0	1

CONTINUED.

Table 2. CONTINUED.

Introduction Number	Name or cross	P.I. No.	Height in cm.	Days to heading	Grain type	Sheath blight	Brown spot	Narrow brown	Leaf smut
DG84165	4440//BG90-2/IR22	PI 503055	90	103	L	4	5	2	6
166	4440//BG90-2/Colombia	PI 503056	105	110	L	4	0	0	0
167	4440//BG90-2/Bahagia	PI 503057	100	112	L	4	5	0	0
168	Cica7//BG90-2/K8	PI 503058	95	119	L	3	4	0	0
169	Cica7//BG90-2/K8	PI 503059	109	138	L	4	3	0	0
170	Cica7//BG90-2/K8		110	138	L	4	3	0	0
171	Cica7//BG90-2/K8	PI 503060	95	112	L	4	4	0	0
172	Cica4//BG90-2/SML56/7	PI 503061	88	98	L	5	3	0	0
173	Cica4//BG90-2/SML56/7		90	114	L	3	3	0	0
174	Cica9//4440/Remedja	PI 503062	93	110	L	4	4	0	0
175	Cica7//4440/Remedja	PI 503063	110	127	L	2	3	0	0
176	Cica7//4440/Remedja	PI 503064	100	131	L	2	3	0	0
177	Cica7//4440/Remedja	PI 503065	92	156	L	3	3	0	0
178	Cica7//4440/Remedja		100	141	L	2	2	0	0
179	Cica7//4440/Pelita 1/1	PI 503066	92	146	L	4	3	0	0
180	Cica7//4440/Pelita 1/1	PI 503067	85	131	L	2	3	0	0
181	Cica7//4440/Pelita 1/1	PI 503068	92	146	L	3	3	0	0
182	Cica7//4440/Pelita 1/1	PI 503069	99	146	L	3	3	0	0
183	Cica7//4440/Pelita 1/1	PI 503070	95	131	L	3	3	0	0
184	Cica7//4440/Pelita 1/1	PI 503071	90	131	L	3	3	0	0
185	Cica7//4440/Pelita 1/1	PI 503072	103	124	L	3	3	0	0
186	O.S.6-1IR.Dwarf (ID)	PI 503073	98	131	L	4	4	0	0
187	O.S.6-2IR.Dwarf (ID)	PI 503074	96	93	BL	3	5	0	0
188	O.S.6-3IR.Dwarf (ID)	PI 503075	100	93	BL	3	5	0	0
189	O.S.6-4IR.Dwarf (ID)	PI 503076	100	131	L	3	3	0	0
190	IAC25-1IR.Dwarf (ID)	PI 503077	91	96	M	5	3	1	0
191	IAC25-2IR.Dwarf (ID)	PI 503078	96	105	L	5	4	0	0
192	IAC25-3IR.Dwarf (ID)	PI 503079	101	103	L	4	6	0	0
193	IAC25-4IR.Dwarf (ID)	PI 503080	100	103	L	4	6	0	0
194	IAC25-5IR.Dwarf (ID)	PI 503081	85	96	L	4	3	1	7
195	IAC25-6 ID	PI 503082	95	121	M	5	4	2	0
196	Tetep 1 ID	PI 503083	116	103	L	6	3	0	0
197	Tetep 2 ID	PI 503084	125	103	BL	4	3	1	2

CONTINUED.

Table 2. CONTINUED.

Introduction Number	Name or cross	P.I. No.	Height in cm.	Days to heading	Grain type	Sheath blight	Brown spot	Narrow brown	Leaf smut
DG84198	Tapucipa-1 ID		90	156	L	3	4	0	0
200	Tapucipa-3 ID	PI 503085	100	159	L	3	4	0	0
201	Tapucipa-4 ID		75	159	L	4	3	0	0
203	Tapucipa-6 ID	PI 503086	90	114	L	3	3	0	0
205	Tapucipa-8 ID		55	189	L	2	3	0	0
206	Taduken 1 ID	PI 503087	84	103	SM	4	2	1	0
208	Cica7//5461/Cica4	PI 503088	90	121	M	6	3	3	0
209	Cica7//5461/Cica4	PI 503089	85	133	L	3	7	0	1
210	Cica7//5461/Cica4	PI 503090	97	110	L	4	4	0	2
211	Cica7//5461/Cica4	PI 503091	99	114	L	4	3	0	0
212	Cica7//5461/Cica4	PI 503092	88	107	L	3	3	0	0
213	Cica7//5461/Cica4	PI 503093	100	124	L	3	3	0	0
214	Cica7//5461/Cica4	PI 503094	102	114	L	4	5	0	0
215	Cica7//5461/Cica4	PI 503095	93	110	L	5	3	0	1
216	Cica7//5461/Cica4	PI 503096	80	131	L	4	4	2	1
217	Cica7//5461/Cica4	PI 503097	91	131	L	4	3	0	0
218	Cica7//5461/Cica4	PI 503098	100	124	L	3	4	0	0
219	Cica7//5461/Cica4	PI 503099	97	119	L	3	3	0	0
220	Cica7//5461/Cica4	PI 503100	100	131	L	3	3	0	0
221	Cica7//5461/4440	PI 503101	100	119	L	6	3	0	0
222	Cica7//5461/4414	PI 503102	100	131	L	4	3	1	0
223	Cica7//5461/IR22	PI 503103	86	124	L	4	3	0	0
224	Cica7//IR36/Cica9	PI 503104	100	131	L	3	4	0	0
225	Cica7//IR36/Cica9	PI 503105	93	124	L	2	3	0	0
226	Cica7//IR36/Cica9	PI 503106	101	124	L	4	5	0	0
227	Cica7//IR36/Cica9	PI 503107	95	131	L	3	6	0	0
228	Cica7//IR36/Cica9	PI 503108	93	119	L	3	4	0	0
229	Cica7//IR36/Cica9	PI 503109	91	121	L	3	4	0	0
230	5461/IR22/IR36/Cica9	PI 503110	91	119	L	5	3	0	0
231	5461/4440//IR36/Cica7		102	154	L	3	2	0	0
232	5461/4440//IR36/Cica7	PI 503111	87	105	L	4	6	0	0
233	M.I. 48-1 ID	PI 503112	80	112	L	4	2	5	6
234	M.I. 48-2 ID	PI 503113	80	91	L	3	4	5	0

CONTINUED.

Table 2. CONTINUED.

Introduction Number	Name or cross	P.I. No.	Height in cm.	Days to heading	Grain type	Sheath blight	Brown spot	Narrow brown	Leaf smut
DG84235	Carreon-1 ID	PI 503114	104	98	L	3	3	0	1
236	P.I. 1846 75-1 ID	PI 503115	87	110	L	5	3	0	1
237	P.I. 1846 75-2 ID	PI 503116	106	131	L	3	4	0	0
238	Buhagia-1 ID	PI 503117	96	110	L	5	6	0	2
239	Buhagia-2 ID	PI 503118	102	110	L	5	5	0	2
240	Buhagia-3 ID	PI 503119	90	110	L	5	6	0	0
241	Composite	PI 503120	91	169	L	3	3	0	0
242	BG90-2//K8/Bahagia	PI 503121	104	138	L	4	3	0	0
243	BG90-2//K8/Bahagia	PI 503122	101	142	L	3	3	0	0
244	4440//BG90-2/SML57/7	PI 503123	86	119	L	4	6	0	0
245	4440//BG90-2/IR22	PI 503124	100	105	L	2	6	1	1
246	4440//BG90-2/Pelita	PI 503125	98	110	L	5	6	0	0
247	4440//BG90-2/Pelita 1/1	PI 503126	97	105	L	7	4	0	0
248	4440//BG90-2/Pelita 1/1	PI 503127	95	112	L	4	6	0	1
249	4440//BG90-2/Pelita 1/1	PI 503128	90	112	L	4	5	0	1
250	4440//BG90-2/Bahagia	PI 503129	91	114	L	4	3	0	1
251	19947 BG90-2/Bahagia	PI 503130	106	112	L	4	3	0	0
252	19950 Cica7//BG90-2/K8	PI 503131	104	142	L	3	3	0	2
253	19952 Cica7//BG90-2/K8	PI 503131	105	114	L	3	3	0	1
254	19953 Cica7//BG90-2/K8	PI 503132	94	119	L	3	4	0	1
255	19954 Cica7//BG90-2/K8	PI 503133	105	140	L	4	3	0	0
256	19957 Cica7//BG90-2/K8	PI 503134	100	110	L	2	4	0	0
257	19958 Cica7//BG90-2/K8	PI 503135	108	131	L	4	2	0	0
258	19959 4440//BG90-2/K8	PI 503136	100	110	L	4	5	0	1
259	19965 4440//BG90-2/K8	PI 503137	96	110	L	4	4	0	0
260	19970 4440//BG90-2/K8	PI 503138	90	107	L	4	5	0	0
261	19971 4440//BG90-2/K8	PI 503139	101	98	L	4	3	0	0

a/ Based on a 0-9 rating scale with 0 representing no infection and 9 representing severe infection, with most of the tissue of each plant killed by sheath blight.

b/ Based on a 0-9 rating scale with 9 representing a very susceptible reaction to leaf smut.

c/ Based on a 0-9 rating scale with 9 representing a very susceptible reaction to narrow brown spot.

d/ Based on a 0-9 rating for disease rating (Ho), lesion number (Ho-N) and lesion size (Ho-S).

e/ Days to heading is the number of days from planting to 50% emergence of the panicles in a plot.

EFFECT OF PREPLANT NITROGEN FERTILIZATION ON RICE DISEASE DEVELOPMENT

(A Progress Report)

D.E. Groth and D.M. Brandon

INTRODUCTION

Nitrogen (N) fertilization of rice (Oryza sativa L.) is an important and necessary practice in Louisiana. Rice varieties vary in the amount of N necessary for maximum yields. Some of the reasons for this include differences in N efficiency, susceptibility to lodging, development of diseases, and other factors. Disease development can be affected by N fertilization because of physiological changes in the leaf and stem, which makes them more or less susceptible to plant pathogens, microenvironment changes caused by differences in the canopy and other morphologic and physiologic changes.

The objectives of this study were: 1) to determine the effect of N fertilization on disease development on various commercial rice varieties and 2) to determine the best N rate at which varietal disease resistance can be determined. This information will also be useful in the development of disease management strategies.

MATERIALS AND METHODS

Disease ratings were collected from the N fertilization field experiments located at the Earl Lounsberry Farm in Vermilion Parish in 1985. Nitrogen was band-placed along with 60 lb/A P_2O_5 and K_2O into the dry seedbed 1 day before water seeding. Nitrogen rates were 0, 30, 60, 90, 120, and 150 lb/A N as ammonium sulfate. Rice varieties were 'Gulfmont', 'Lemont', 'Mars', and 'Newbonnet'. The planting date was March 21. The plots were drained 6 days after seeding to encourage seedling anchorage, and a permanent flood was established 8 days after planting. Plots were combine-harvested at plant maturity and yields at 12% moisture were determined. Additional detailed information on methods can be found in this publication in the rice fertilization section (1). Nitrogen (whole-plots) and varieties (split-plots) were arranged in a randomized, complete block design with four replications. Disease ratings were taken 1 to 2 weeks before harvest for each variety. Sheath blight (Rhizoctonia solani), brown spot (Bipolaris oryzae), narrow brown spot (Cercospora oryzae), sheath rot (Acrocyldrium oryzae), and leaf smut (Entyloma oryzae) were rated on a 0 to 9 scale where 0 represents no disease and 9 severe disease (2).

RESULTS AND DISCUSSION

Yields of early long-grain varieties Lemont, Newbonnet and Gulfmont were maximized at 90 to 120 lb N/A (Figures 1 and 2). Yield of the medium-grain variety Mars was maximized at 60 lb N/A. In general, brown spot and sheath rot severity on all varieties decreased with increasing N rates. Sheath blight and leaf smut increased with increasing N rates and narrow brown spot was not significantly affected by N rate. Mars was most resistant to sheath blight, narrow brown spot, leaf smut, and sheath rot. Newbonnet was most resistant to brown spot.

Sufficient disease development occurred at 90 to 120 lb N/A to determine disease reactions of the five diseases on each variety. At lower N rates (0 to 60 lb N/A), sheath blight did not develop to levels high enough to consistently rate resistance and at 150 lb N/A brown spot development was poor. Disease pressure was moderate in this experiment.

In the management of diseases, it appears that adjusting N fertilization for maximum yields is most important. It was noted that when the yield was maximized, most diseases were minimized or not at their maximum. In addition, lodging was also minimized at these N rates, which tends to lower disease severity. Additional information on yields, N concentrations in the leaves, lodging, plant height, etc., are available in the rice fertilization section (1).

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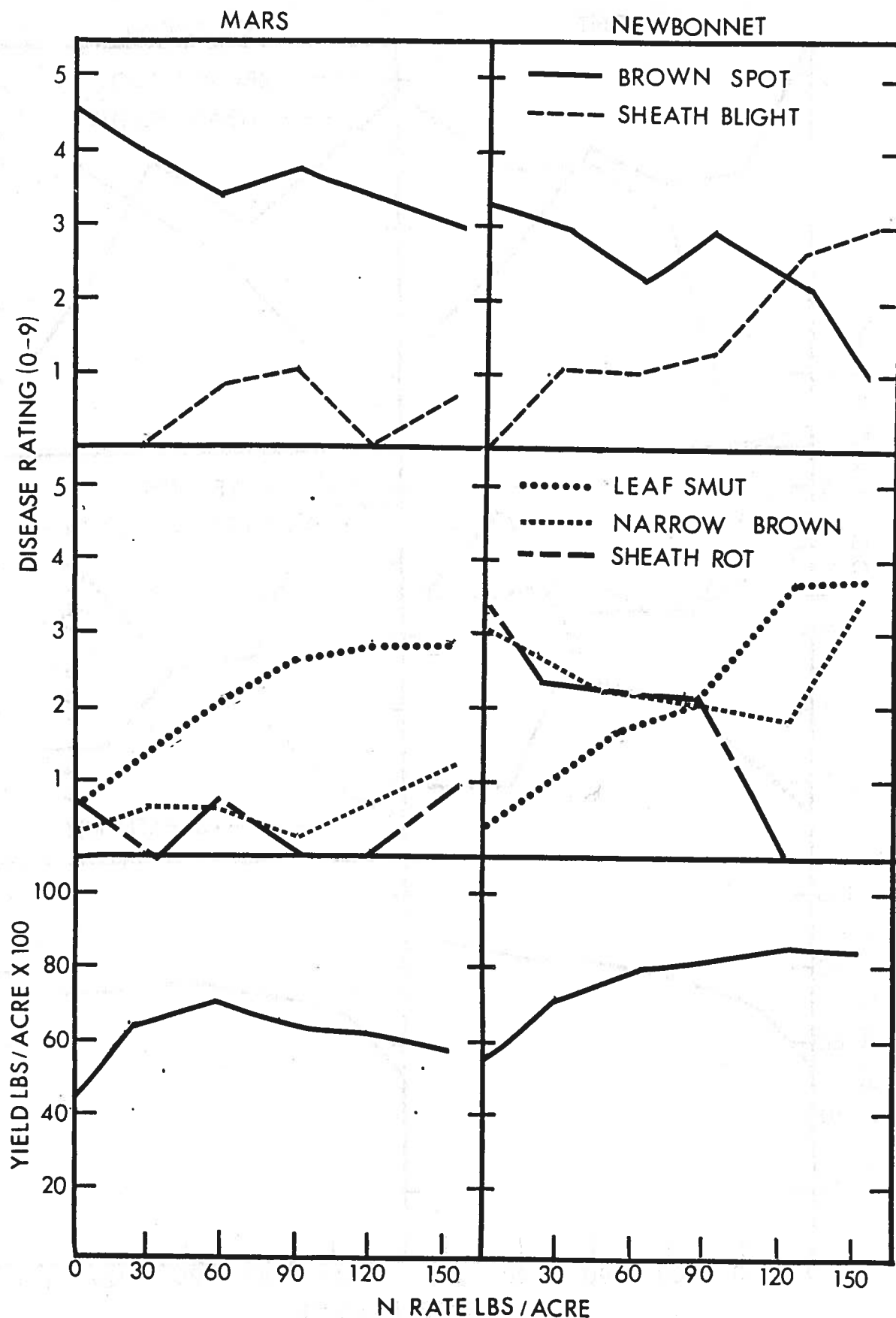


Figure 1. The effect of preplant nitrogen (N) fertilization rate on development of brown leaf spot, sheath blight, leaf smut, sheath rot, and narrow brown leaf spot disease and grain yields of the early varieties Mars and Newbonnet in Vermilion Parish in 1985.

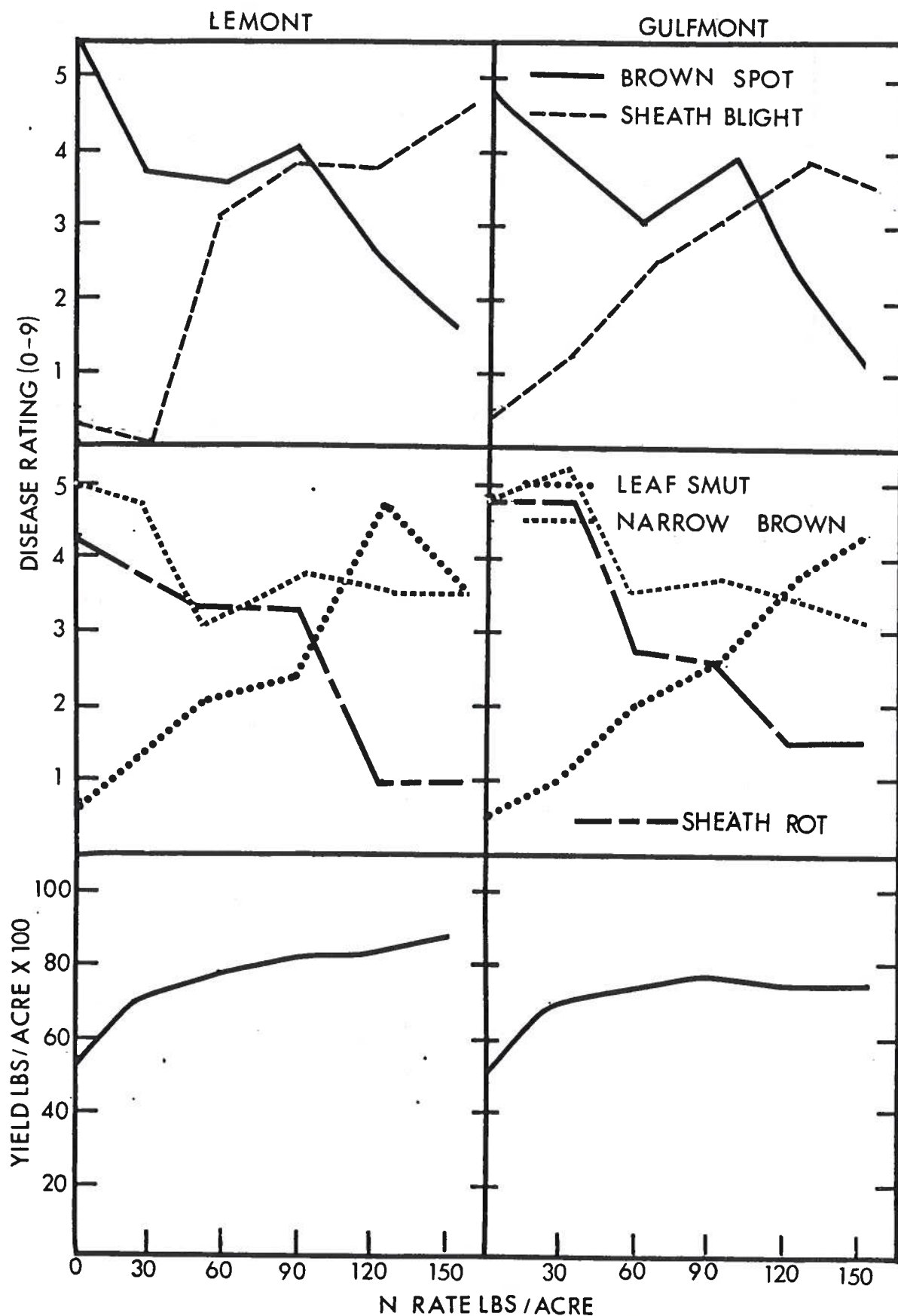


Figure 2. The effect of preplant nitrogen (N) fertilization rate on development of brown leaf spot, sheath blight, leaf smut, sheath rot, and narrow brown leaf spot disease and grain yields of the early varieties Lemont and Gulfmont in Vermilion Parish, 1985.

COMMERCIAL RICE FUNGICIDE TESTS

(A Preliminary Report)

D.E. Groth, M. Frey, and J. Nugent

INTRODUCTION

Some of the most important and endemic diseases in Louisiana are sheath blight, brown spot, narrow brown spot, and leaf smut. Control of these diseases will probably include selecting the most resistant variety, managing the crop for maximum yield, and applying a fungicide when the disease is expected to exceed the economic threshold. Unfortunately, disease resistance is not always available and often cultural management is ineffective and impractical so the rice producer must rely on the use of fungicides. Therefore, the testing of chemicals for control of rice diseases is an important part of developing a management program. The objective of this study was to evaluate labelled or near to being labelled chemical control agents in reducing disease levels.

MATERIALS AND METHODS

The experiment was planted at the Rice Research Station in Crowley, LA on April 11, 1985. Fertilizer was preplant incorporated at a rate of 60-60-60 lb/A N-P₂O₅-K₂O, 1 to 2 inches deep. The variety was Labelle and plots consisted of seven rows 16 ft long with 7-in row spacing. The experiment was arranged in a randomized complete block design with five replications. Propanil was applied at 4 lb/A to control weeds and carbofuran was applied to control rice water weevils. A permanent flood was established as soon as seedlings had emerged 2 to 4 inches. Inoculated plots had a moist, autoclaved rice grain:rice hull (1:2) medium culture of Rhizoctonia solani (isolate LR-172) applied at the green ring growth stage at the rate of 100 ml of inoculum per plot. Plots were sprayed with the fungicides on June 20 and July 3 which corresponded with 1- to 2-in panicle and 10% heading. The fungicides were applied in water at 20 gal/A, with a back-pack type solo sprayer using a low drift nozzle. Treatments were arranged in a randomized complete block design with five replications. The treatments are listed in Table 1. Plots were rated for disease severities 2 to 3 days before harvest for sheath blight, brown spot, narrow brown spot, and leaf smut. The center four rows were harvested with a small plot combine. Sample weight and moisture content were determined and rough rice grain yields were calculated as lb/A at 12% moisture for each treatment.

RESULTS AND DISCUSSION

Results of the fungicide spray trial are shown in Table 1. Yield losses due to diseases, especially sheath blight, were very low with a 283 lb/A difference between the inoculated and uninoculated check. Benlate increased yields by 100 lb/A and Tilt and Rovral increased yields by almost 200 lb/A but

Table 1. The effect of fungicidal sprays on yield and disease control in Labelle rice inoculated with sheath blight fungus and naturally infected with brown spot, narrow brown spot, and leaf smut fungi. Rice Research Station, Crowley, LA. 1985.

Treatment ^{a/}	Timing	Rate formulated	Mean yield	Change from unsprayed	Sheath blight ^{b/} rating	Brown ^{b/} spot	Narrow ^{b/} Brown	Leaf ^{b/} smut
				----- (lb/A) -----				
Uninoculated control	---	---	7065	283	0.8 c ^{c/}	2.4 a	2.6 a	0.6 ab
Inoculated control	---	---	6782	---	5.4 a	2.6 a	2.2 a	0.8 a
Benlate	EB + H	1 lb	6882	100	3.2 b	1.8 b	1.4 ab	0.2 ab
Tilt 3.6E	EB + H	6 oz	6974	192	2.0 c	0.4 c	0.0 b	0.0 b
Rovral	EB + H	1 lb	6962	180	2.0 c	0.6 c	2.0 a	0.4 ab
LSD (0.05)				(462)	(1.4)	(0.9)	(1.7)	(0.7)

^{a/} Treatment applied at the indicated rate/A in 20 gal/A of water at early boot (1- to 2-in panicle) and early heading.

^{b/} Diseases rated on 0 to 9 scales with 0 = no disease and 9 = severe disease.

^{c/} Significantly different at 5% level using a protected Duncan's multiple range comparison (i.e. ANOVA significant for trt.).

there were no statistical differences between treatments. Both Tilt and Rovral gave good control of sheath blight and brown spot and Benlate did a fair job. Tilt eliminated narrow brown spot and leaf smut from the plots but Rovral did not have much activity against narrow brown spot and leaf smut. Benlate reduced both narrow brown spot and leaf smut levels but not as well as Tilt.

Disease pressure was low in the experimental plots in 1985 and yield responses from the fungicide applications probably would have been higher under heavier disease conditions. Both Tilt and Rovral effectively controlled sheath blight at the rates used. Tilt, however, will be used at earlier times than early boot and heading and this may affect its performance.

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RICE DISEASE ASSESSMENT KEYS

(A Preliminary Report)

D.E. Groth and M.C. Rush

INTRODUCTION

A standard system for scoring rice disease severity is important to rice scientists to uniformly evaluate disease reactions. A uniform scale permits accurate and rapid comparison of evaluations from various studies by different researchers. Some areas of use would be the evaluation of varietal disease reactions, breeding lines for disease resistance, and estimating severity of disease in small experimental plots and commercial fields. One of the problems encountered in the process of evaluation is the interpretation of complex written disease scales. The simplest method to overcome this problem is to develop pictorial disease scales to go along with the written ones. The purpose of this report is to provide both written and pictorial disease scales for use by rice scientists, extension personnel, and other rice workers in evaluating rice disease severities and disease reactions.

MATERIALS AND METHODS

Written disease assessment keys are presented in Tables 1 thru 4 and pictorial scales in Fig. 1 thru 3 for sheath blight (1) caused by Rizoctonia solani, brown spot (2) caused by Bipolaris oryzae, narrow brown spot caused by Cercospora oryzae, and leaf smut (3) caused by Entyloma oryzae. These scales were developed for the evaluation of disease resistance in rice lines planted in rows in the field. The scales go from 0 to 9 where 0 indicates no disease and 9 indicates severe disease development. Usually a 0 to 3 rating represents a resistant reaction (I = immune, VR = very resistant, R = resistant); 4 to 6 (MS = moderately resistant, M = moderate resistant, and HM = high intermediate), an intermediate reaction; and 7 to 9 (MS = moderately susceptible, S = susceptible, and VS = very susceptible), a susceptible reaction. When using these scales in the field, multiple evaluations at different locations in the field should be averaged to give a good estimate of the disease condition in that field.

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Table 1. Rating system for determining resistance to Rhizoctonia solani (Sheath blight).

Disease reaction	Sheath blight rating scale
(I)	0 = Plants healthy, no symptoms.
(VR)	1 = Restricted oval lesions at water-line or inoculation points, lesion centers grey-green to nearly white, margin or lesion a broad red-brown or purple-brown border usually broader than necrotic center, less than 2.5% of tissues affected.
(R)	2 = Few oval or coalesced lesions on lower sheaths or at infection points, lesions with broad red-brown border, 5% or less of tissues affected.
(MR)	3 = Lesions on lower leaf sheaths or at inoculation points, lesions with narrow red-brown border, coalescing, less than 10% of tissues affected.
(LM)	4 = Lesions mainly restricted to sheaths on lower third of plant, lowest leaves, or inoculation points, lesions discrete or coalescing with narrow red-brown border, 10 to 15% of leaf and sheath tissues affected.
(M)	5 = Lesions mainly restricted to sheaths and leaves of lower half of plants, lesions usually coalescing with large necrotic centers and narrow red-brown borders, 15 to 25% of tissues affected, culm not injured.
(HM)	6 = Lesions usually coalescing and affecting lower 2/3 of sheath area of plant, lesions extending to blades of lower leaves or lower leaves killed by injury to sheath, 25 to 40% of tissues affected, culm of infected tillers usually not affected.
(MS)	7 = Lesions usually coalescing and affecting lower 3/4 of sheath area of plant, lesions extending to leaf blades of lower 2/3 of plant, 40 to 60% of tissues affected, outer portion of culm may be brown or have brown streaks near water-line.
(S)	8 = Lesions reaching to flag leaf, lower sheaths with coalesced lesions covering most of tissue, lower and middle leaves dead or dying, 60 to 80% of tissues affected, culms with brown streaks or turning light brown to center and water-soaked, severely affected tillers lodging, florets in lower 1/3 of panicle often not filling.
(VS)	9 = Lesions reaching to flag leaf, lower leaves mostly dead, sheaths dried, culms brown, water-soaked or collapsing, most of tillers lodged, florets in lower 1/3 to 1/2 of panicle not filling.

Table 2. Rating system for determining resistance to Helminthosporium oryzae (Brown spot).

Disease reaction		H.o. rating scale	H.o./A (lesion diameter mm)	Scales ^{a/} H.o./N (lesion no. approx. 20 sq cm)
(I)	0	Plants healthy, no symptoms	0	0
(VR)	1	Few to many dark specks of pin-head size, no necrosis (collapsed cells).	pin	1-2
(R)	2	Dark brown specks, 0.5 to 1 mm in diameter, no necrosis.	specks	3-5
(MR)	3	Small round or oval brown spots, 1 to 2 mm in diameter, no necrosis or grey in centers.	1-2	5-8
(LIM)	4	A few (10/leaf or less) dark brown spots, 2 to 3 mm in diameter, grey necrotic area in center.	2-3	8-10
(IM)	5	Less than 15 lesions/leaf of typical circular or oval spots, spots 2 to 4 mm with grey necrotic centers and brown margin, many have chlorotic halo around spots.	3-4	10-15
(HIM)	6	Fifteen to 25 typical brown spot lesions/leaf; circular, oval, or sometimes linear, 3 to 5 mm in diameter or length, with large necrotic center and brown margin, often with yellow or gold halo around lesion.	4-5	15-25
(MS)	7	Less than 50 lesions/leaf, lesions oval to elongated, 4 to 6 mm in diameter or length, lesions mainly with grey necrotic centers, narrow brown margin.	5-6	25-50
(S)	8	Many (50 to 75) lesions/leaf of group 7 size or larger, less than 25% of leaf area killed by coalescence of lesions.	6-8	50-75
(VS)	9	More than 75 lesions/leaf of group 7 size or larger (usually 6 to 10 mm) more than 25% of leaf area killed by coalescence of lesions.	8	>75

^{a/} Scales are based on evaluating a leaf area of about 20 sq cm/leaf. Usually the flag leaf and next lower leaf were evaluated.

Table 3. Rating system for determining resistance to Cercospora oryzae (Narrow brown spot).

Disease reaction		Narrow brown rating scale	C.o./A (lesion length mm)	Scales ^{a/} C.o./N (lesion no. approx. 20 sq cm)
(I)	0	Plants healthy, no symptoms	0	0
(VR)	1	Few to many dark specks of pin-head size, no necrosis (collapsed cells).	pin	1-2
(R)	2	Dark brown specks, 0.5 to 1 mm in diameter, no necrosis.	specks	3-5
(MR)	3	Small linear reddish-brown spots, 1 to 2 mm in length, about 0.5 mm wide.	1-2	5-10
(LIM)	4	A few (15/leaf or less) reddish-brown spots, 3 to 4 mm in length, less than 1 mm wide.	3-4	10-15
(IM)	5	Less than 25 lesions/leaf of typical linear spots, spots 5 to 6 mm long and less than 1 mm wide.	5-6	15-25
(HIM)	6	Twenty-five to 50 typical narrow brown spot lesions/leaf; linear, 7 to 10 mm in length, 1 mm wide.	7-10	25-50
(MS)	7	Less than 75 lesions/leaf, lesions 4 to 6 mm in length, some lesions may have grey necrotic centers with narrow brown margin, 1 to 1.5 mm wide.	10-15	50-75
(S)	8	Many (75 to 100) lesions/leaf of group 7 size or larger, less than 25% of leaf area killed by coalescence of lesions.	>15	75-100
(VS)	9	More than 100 lesions/leaf of group 7 size or larger (usually 10 to 20 mm) more than 25% of leaf area killed by coalescence of lesions.	>15	>100

^{a/} Scales are based on evaluating a leaf area of about 20 sq cm/leaf. Usually the flag leaf and next lower leaf were evaluated.

Table 4. Rating system for determining resistance to Entyloma oryzae.

Rating	Description
0	<u>Immune reaction</u> . No evidence of infection.
1	<u>Highly resistant</u> . Only one to three lesions of minute size, less than 0.5 mm in length and 0.1 mm in width, produced on the flag leaf.
2	<u>Very resistant</u> . About four to 10 lesions of minute size, less than 0.5 mm in length and 0.1 mm in width, produced on the flag leaf covering 1.0 to 2.0% of the total flag leaf area.
3	<u>Resistant</u> . Not more than 100 sori of about the same size as class 2, but covering up to 10% of the total flag leaf area.
4	<u>High intermediate</u> . More than 100 sori of the size 1.0 mm in length and 0.5 mm in width produced on the flag leaf covering about 10 to 30% of the total flag leaf area.
5	<u>Intermediate</u> . Medium size sori, about 1.5 mm in length and 1.0 mm in width, produced on the flag leaf covering about 30 to 50% of the total flag leaf area.
6	<u>Low intermediate</u> . Larger sori, about 2.0 mm in length and 1.0 mm in width, produced on the flag leaf covering about 50 to 60% of the total flag leaf area.
7	<u>Susceptible</u> . About the same size of sori as class 6 but covering about 60 to 70% of the total flag leaf area.
8	<u>Very susceptible</u> . Large sori, 2.5 to 3.5 mm in length and 2.0 mm in width produced on the flag leaf covering about 70 to 80% of the total flag leaf area. The flag leaf starts to die but some green parts remain.
9	<u>Highly susceptible</u> . Almost all sori coalesce and the size of the lesion is not discernible. The flag leaf area is covered by sori.



Figure 1. Pictorial rating system for sheath blight. Scale 1/4X.



DISEASE REACTION

LESION NUMBER

Figure 2.
Pictorial rating system for brown
spot. Scale disease reaction and
lesion number 1/2X, lesion size 1X.

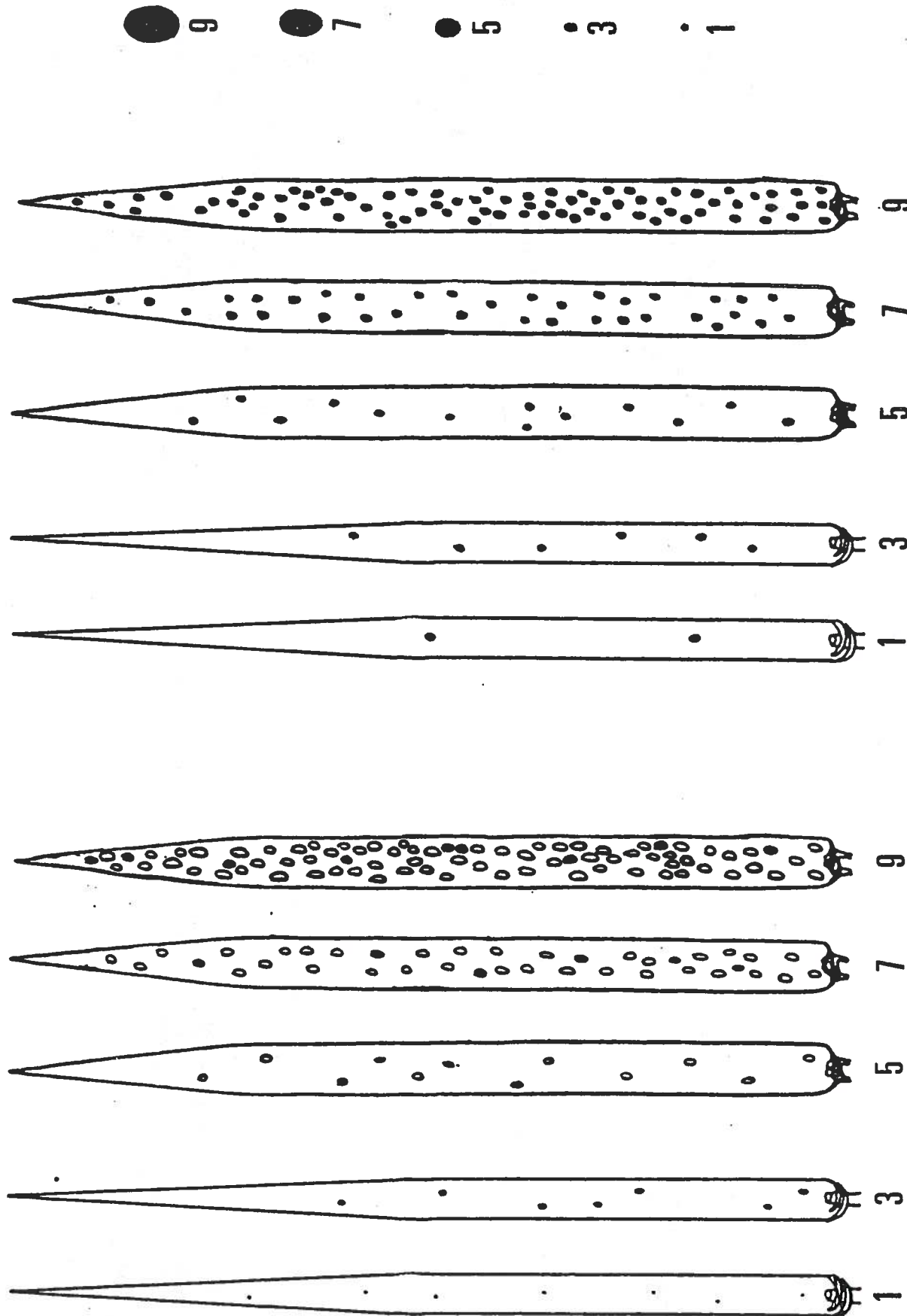
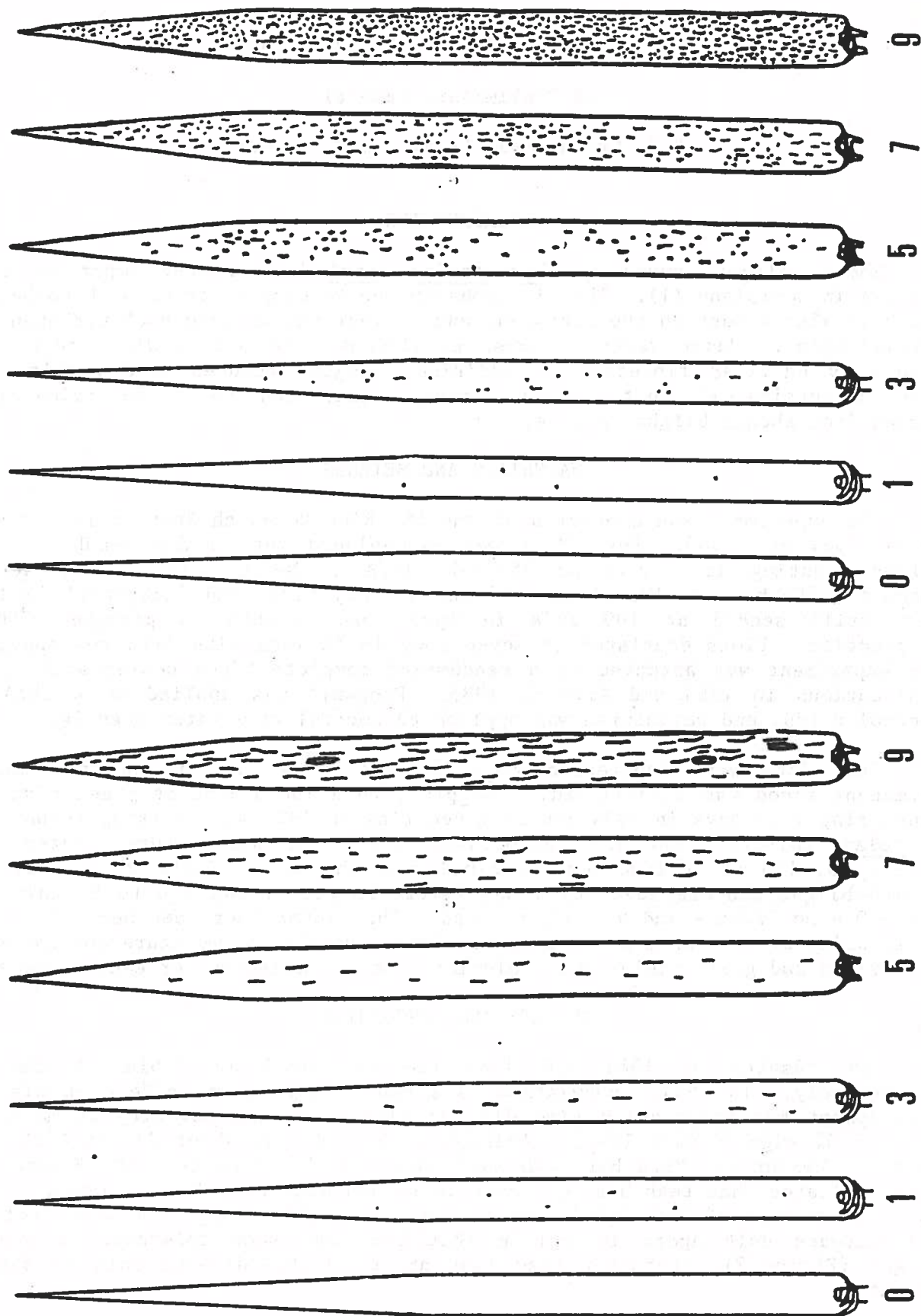


Figure 3. Pictorial rating system for leaf smut and narrow brown spot.
Scale 1/2X.



NARROW BROWN

LEAF SMUT

YIELD LOSSES DUE TO SHEATH BLIGHT

(A Preliminary Report)

D.E. Groth, M.J. Frey, and J. Nugent

INTRODUCTION

Sheath blight caused by Rhizoctonia solani is the most important rice disease in Louisiana (1). This is probably due to crop rotation with soybeans, which is also a host to the pathogen, and an increase in levels of nitrogen (N) fertilization. Under severe disease conditions rice plants die, lodge, and have many unfilled florets. In addition, lodging reduces seed quality and makes harvesting difficult. The objective of this study was to determine yield losses from sheath blight on rice.

MATERIALS AND METHODS

The experiment was conducted at the LSU Rice Research Station in Crowley, LA in 1984 and 1985. Fertilizer was band-placed into a dry seedbed 1 day before planting at a rate of 75-75-75 lb/A of $N-P_2O_5-K_2O$. The varieties 'Lemont', 'Leah', and 'Mars' in 1984 and Lemont, Leah, and 'Lebonnet' in 1985 were drill seeded at 100 lb/A in April and flushed to promote uniform germination. Plots consisted of seven rows 16 ft long with 7-in row spacing. The experiment was arranged in a randomized complete block design with three replications in 1984 and five in 1985. Propanil was applied at 4 lb/A to control weeds, and carbofuran was applied to control rice water weevils.

The plots were topdressed with 75 lb/A N as ammonium sulfate and a permanent flood was established. The plots were inoculated at green ring and green ring + 14 days in 1984 and at green ring in 1985 with varying amounts of R. solani culture grown on an autoclaved rice grain-hull mixture. Rates were 0, 25, 50, 100 ml of inoculum scattered over the plot. Plots were rated for sheath blight disease severity 1 day before harvest using a 0 to 9 scale (1) where 0 = no disease and 9 = plants dead. The center four rows were harvested at maturity with a small plot combine. Sample weight and moisture content were determined and grain yields were calculated at 12% moisture for each treatment.

RESULTS AND DISCUSSION

The results of 1984 and 1985 are presented in Tables 1 and 2, respectively. In 1984, inoculation rate had a significant effect on disease development but inoculation time did not effect disease severity at maturity using a 5% significance level. Average yield loss was about 230 lb/A/disease unit for Lemont and Mars but Leah lost only 140 lb/A/disease unit (Figure 1). This indicates that Leah has tolerance to sheath blight. In 1985, Lemont plots lost an average of 220 lb/A/disease unit to sheath blight and Leah lost 70 lb/A/disease unit again indicating that Leah has some tolerance to sheath blight (Figure 2). Lebonnet also lost about 80 lb/A/disease unit to sheath blight.

Table 1. Effect of sheath blight inoculation and timing on disease development and yield. Rice Research Station, Crowley, LA. 1984.

Inoculation time ^{a/}	Inoculum rate ^{b/}	Disease rating ^{c/}	Yield ^{d/} (lb/A)
<u>Lemont</u>			
0	0	0.0	7217
1	25	4.0	6088
1	75	4.0	7037
1	100	7.0	5345
2	25	3.0	6416
2	75	5.0	6558
2	100	6.3	5701
<u>Leah</u>			
0	0	0.3	8200
1	25	4.0	7023
1	75	5.3	7231
1	100	6.0	7121
2	25	3.3	7884
2	75	3.7	7567
2	100	6.3	7453
<u>Mars</u>			
0	0	0.0	8591
1	25	3.7	8482
1	75	3.7	6895
1	100	4.3	7411
2	25	2.7	7460
2	75	2.3	7582
2	100	3.3	8020

a/ Time of inoculation 0 = no inoculation, 1 = green ring, and 2 = green ring + 14 days.

b/ Rate of inoculum in mils/plot sprinkled over whole plot.

c/ Disease rating using 0 to 9 scale at harvest maturity.

d/ Yield in lb/A at 12% moisture.

Table 2. Effect of sheath blight inoculation rate on disease development and yield. Rice Research Station, Crowley, LA. 1985.

Rate ^{a/}	Disease ^{b/} rating	Yield ^{c/} (lb/A)
<u>Lemont</u>		
0	2.0	7540
25	6.2	6780
50	7.0	6512
75	7.0	6551
100	8.0	6008
<u>Leah</u>		
0	1.0	7421
25	2.7	7315
50	3.8	7053
75	5.7	7191
100	5.5	7060
<u>Lebonnet</u>		
0	2.7	7345
25	5.3	7008
50	4.7	7167
75	5.8	7039
100	6.1	6812

^{a/} Rate of Rhizoctonia solani inoculum placed on plots at green ring growth stage.

^{b/} Disease rating on 0 to 9 scale at harvest maturity.

^{c/} Yield as lb/A at 12% moisture.

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Figure 1.. Individual plots of Lemont, Mars, and Leah plotted by disease rating x yield in lb/A. Rice Research Station. 1984

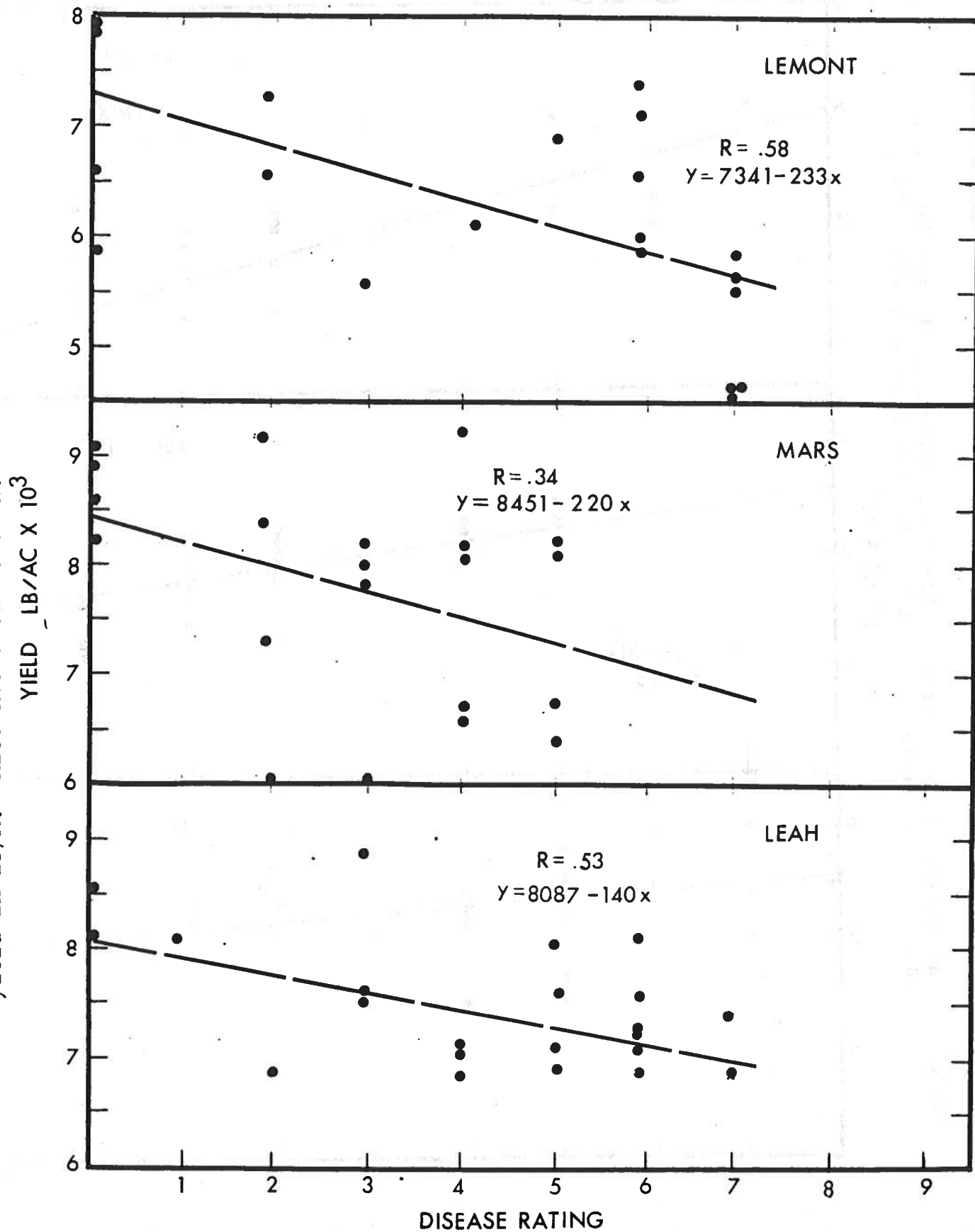
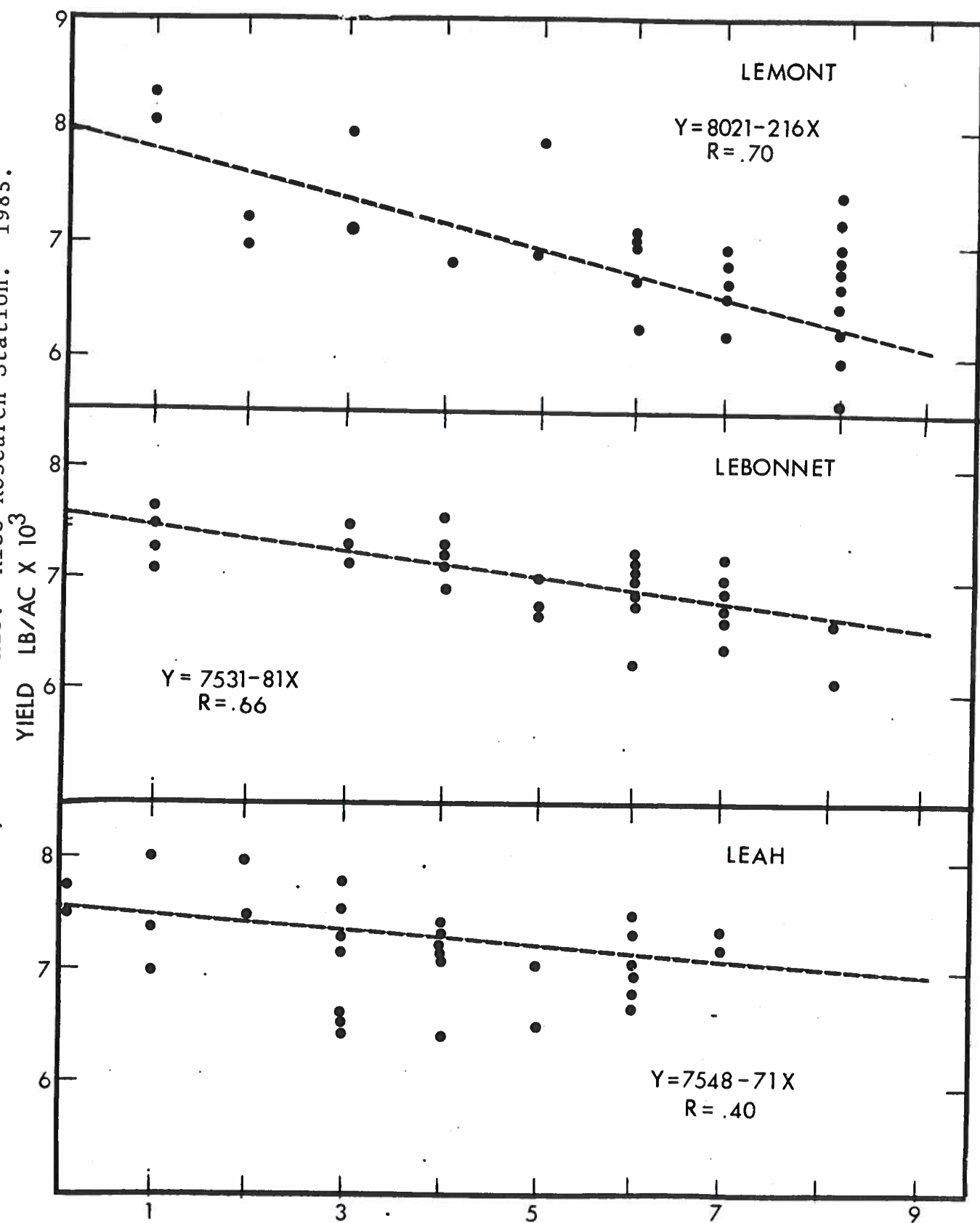


Figure 2. Individual plots of Lemont, Lebonnet, and Leah plotted by disease rating on X axis and yield on Y axis. Rice Research Station. 1985.



EPIDEMIOLOGY OF RICE BLAST UNDER DIFFERENT WATER MANAGEMENT PRACTICES

(A Preliminary Report)

C.H. Kim, M.C. Rush, and D.R. MacKenzie

INTRODUCTION

It has been reported since the early 1900's that rice plants grown in dry soil are more susceptible to blast than plants grown in flooded soil. It was suggested that more silication of leaf epidermal cells of the plants grown in flooded soil was associated with resistance under flooded conditions. In the 1950's, differences in nitrogen content in leaf tissues of plants between upland and flooded conditions were found and proposed as a major factor responsible for the differences in blast susceptibility between the two conditions. Possible differences in microclimate between flooded or unflooded conditions were also considered by some researchers as the cause of the difference in disease severity between the two conditions. Despite these early observations, extensive research has not been conducted. Consequently, the reason for high blast susceptibility of plants grown under dry soil conditions still is not well understood. This research was conducted to examine the nature of blast development under different water management systems.

MATERIALS AND METHODS

Two rice varieties, 'M-201' and 'Brazos' were drill planted with a six-row planter spaced 7 inches apart at the rate of 100 lb/A on May 6, 1985. Fertilizer was applied at planting at a rate of 600 lb/A of 20-10-10 ($N-P_2O_5-K_2O$). A split plot design was used by assigning water management systems as main plots and the two varieties as subplots. Each subplot consisted of 18-row drill strips spaced 7 inches apart and 20 ft long. Irrigation and drainage of individual plots were independently controlled by individual water gates. There were four water management practices: continuous flooded, continuous upland, flooded changed to upland, and upland changed to flooded. Water management treatments started from 29 days after planting and changes of water management practices for the two alternate treatments were made 34 days from the beginning of treatment. Microclimate conditions in upland and flooded plots were continuously monitored during the growing season using a CR-21 micrologger and two units of BC-560 microcomputers. The field was inoculated with race IH-1 of Pyricularia oryzae at 6 days after the beginning of water management treatments by transplanting a single infected plant into each subplot. Disease progress was examined at 7-day intervals. For yield determination, 16 ft of the eight center rows in each subplot were harvested with a small plot combine on September 18. For the analyses of leaf mineral nutrition, leaf samples of plants grown in each treatment were sequentially collected 10 times at 6- to 14-day intervals starting from 7 days after water management treatments began. At each sampling time, a total of 50 leaves consisting of the uppermost two leaves, was collected from plants randomly selected in each plot.

RESULTS AND DISCUSSION

Blast development on the varieties Brazos and M-201 was significantly affected by water management practices. Disease progressed rapidly in upland plots, but was greatly reduced in flooded plots. Final disease severity under upland conditions averaged 88 and 32% for M-201 and Brazos, respectively. Final disease severity in flooded conditions was 2.1 and 0.1% for M-201 and Brazos, respectively. Number of lesions and conidia per lesion were significantly greater under upland conditions. Lesion size did not differ significantly between upland and flooded conditions. When upland plots were flooded after an epidemic was initiated, further blast development was greatly decreased for Brazos but was not significantly affected for M-201. No increase in disease was observed for both varieties after flooded plots were drained and maintained under upland conditions.

Ambient air temperature did not differ significantly between the two conditions. However, daily maximum temperature was higher under upland conditions. Duration of leaf-wetness period was longer in flooded plots. Relative humidity was higher under flooded conditions. From these results, it was concluded that microclimates in flooded plots were at least equal to or more favorable for blast development than upland plots.

Silica, manganese, and sodium content in leaf tissues were significantly greater in the leaf samples from flooded conditions. Nitrogen and sulfur content were higher in the leaf samples from upland conditions. Phosphorus, potassium, magnesium, calcium, iron, zinc, copper, aluminum, and boron content in leaf tissues were not significantly different between leaf samples from upland and flooded plots.

The variety M-201 was more severely infected by rotten neck blast than Brazos. Infections of panicle blast on M-201 ranged from 48 to 76%, depending on the specific water management treatment, but the differences were not statistically significant. Development of panicle blast on Brazos was significantly affected by water management practices. About four times more panicles were infected under upland conditions than flooded conditions.

Yields of Brazos and M-201 were greatly affected by the differences in blast due to the different water management practices. Yield of upland plots was approximately 5 and 14% of those of flooded plots. Yield losses due to blast alone in upland plots were estimated as 90 and 74% for M-201 and Brazos, respectively. Yields in flooded plots were also reduced due to panicle blast infections in both varieties. These losses were estimated as 51 and 14% for M-201 and Brazos, respectively. Yields in the plots changed from flooded to upland plots were generally less than yields of flooded plots, but the differences were not significant. Yields in the plots changed from upland to flooded conditions reflected the differential pattern of two varieties for blast development in this water management treatment. Yields in this treatment were significantly increased with Brazos, compared to the yield of the upland treatment, but were not significantly different with M-201.

These results suggest that the differences in blast development between upland and flooded conditions were associated with physiological changes of plants under those two conditions, rather than microclimate differences. These changes apparently affected plant defense mechanisms associated with the infection process.

INHERITANCE OF SHEATH BLIGHT RESISTANCE IN RICE^{1/}

(A Progress Report)

B. J. Hoff, F. Jeutong, and M. C. Rush

INTRODUCTION

Sheath blight of rice caused by Rhizoctonia solani Kuhn is currently the most damaging rice disease in Louisiana. Chemical control of this disease is expensive and not completely effective. None of the long grain rice varieties currently grown in Louisiana are resistant to this disease. Sources of resistance to sheath blight have been identified, however, all resistant varieties have either unsatisfactory grain quality, poor agronomic characteristics or poor adaptation to Louisiana conditions. The objectives of this research was to evaluate procedures for identifying and selecting individual resistant plants in segregating populations of rice and to study the inheritance in rice of resistance to sheath blight.

MATERIALS AND METHODS

The plants used in this study consisted of check varieties, parent lines, and F₁, F₂, and F₃ progenies of the following crosses: 'RG93' x 'Labelle', 'RG94' x Labelle, and Labelle x 'RG95'.

The following varieties were used in this study as check cultivars: 'Lebonnet' (CI9882), 'Starbonnet' (CI9584), 'Leah' (CI9979), 'Saturn' (CI9450), 'Nato' (CI8998), 'Nortai' (CI9836), 'Melrose' (Prop. var.), 'Taducan' (PI280681), and 'Tetep' (PI280682).

The RG93, RG94, and RG95 (no P.I. number available) lines were sister selections from a heterogeneous line with a high level of resistance to sheath blight. This line was introduced from China by Dr. M. C. Rush and was reported to be the progeny of a rice x wild grass cross. Except for its dwarf stature, this line appeared to have all the characteristics of normal rice.

The plant materials were evaluated for sheath blight infection in a greenhouse on the Louisiana State University Campus, Baton Rouge, Louisiana. The greenhouse was heated or evaporatively cooled as necessary to maintain a temperature between 80 and 90°F. When testing for sheath blight resistance, the seeds were planted ¼ inch deep, in steam sterilized Olivier silt loam soil in galvanized metal flats with a soil depth of approximately 4 inches. The flats were placed on a wooden bench which had been lined with polyethylene

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

plastic sheeting to produce a waterproof basin to flood the soil as necessary. Six rows (20 inches long with 2 inches between rows) were marked on each flat. Each 10 plant row was used as an experimental unit. The 400 F_2 seeds from each of the RG93 x Labelle and RG94 x Labelle crosses, 352 F_2 seeds from the Labelle x RG95 cross, 40 seeds of each of the parental lines, and 40 seeds of each check cultivar were then assigned to rows using a completely randomized design. The seeds were spaced 2 inches apart within the row and lightly covered with soil. Soon after the F_2 seeds were planted, the bench was flooded to a depth of approximately 2 inches with deionized water. Ratoon tiller shoots were obtained from the F_1 plants and transplanted into assigned rows. Twelve, 14, and 10 tillers selected to have approximately the same height as the F_2 seedlings were obtained from the original F_1 plants from the crosses RG93 x Labelle, RG94 x Labelle, and Labelle x RG95, respectively. Transplantation of these ratoon F_1 plants was done during the fourth week after planting.

For inoculation of these tests a rice grain-rice hull-fungus inoculum was used. The inoculum was prepared in the laboratory using *R. solani* isolate LR172, and applied to the base of the 34 day old seedlings. Before applying the inoculum to the base of the seedlings, sections of white polyvinylchloride (PVC) pipe (19 inches long and 1.75 inches in diameter) which had been cut in half length-wise, were carefully inserted between the rows of the seedlings with the open side of the pipe sections placed on top of the soil. These pipes produced a V shaped channel next to the base of the seedlings, which allowed the inoculum to readily lodge against the base of the plants. The V shaped channel also kept the inoculum out of contact with the wet soil. The plants were inoculated by distributing 4 to 5 ml of inoculum to the base of each seedling. After the inoculum was distributed, a sheet of clear polyethylene plastic was placed over the frame of the wooden bench and stapled tightly shut, creating a 4 ft high chamber in which a high relative humidity was maintained. The plastic humidity chamber remained closed until removed from the bench 21 days after inoculation. The individual plants were then rated or evaluated for the level of sheath blight infection by three related but different methods.

Evaluation Method 1 included 10 classes derived from a 0 to 9 rating scale based on the type lesion and a rough estimate of the sheath area infected. This method was modeled after the rating system described by Hoff et al. (1975), but was modified for individual plant evaluations at the vegetative stage.

Evaluation Method 2 was based on visual estimation of sheath area infected, which was expressed in percentage of the total sheath area. Precise visual estimates of diseased sheath surface were difficult to obtain; therefore, a scale using a 5 percentage point group allowed the grouping of the observations into 20 classes.

Evaluation Method 3 was based on the ratio of the cumulative lesion height to total plant height measured from the base of the plant to the uppermost leaf collar. The number of possible classes with this method were infinite; but for a realistic comparison with Method 2, the ratio was expressed in percent and 20 classes were derived on the same basis used in Method 2.

The experimental conditions for the evaluation of F_3 progenies during the second test were similar to the procedures used to evaluate the F_1 and F_2 progenies. Each F_3 family was used as a treatment and the seedling density doubled (10 seeds planted on a half row) due to the limited availability of space. The check cultivars were Tetep, Nato, Leah, Lebonnet, and 'L201' (CI9971). The number of plants per check cultivar was also reduced to 20 plants. The inoculum was applied to the F_3 progeny test at a similar stage of development as the F_2 plants in the previous test.

For statistical analysis, the parental lines, and the F_1 and F_2 progeny populations were evaluated using a completely randomized design with rows (10 plants) used as the experimental unit. The F_3 lines were evaluated using a randomized block design with rows (10 plants) used as the experimental unit.

The number of genes controlling resistance to sheath blight was estimated for each evaluation technique using two procedures. Chi-square statistics were used to evaluate the goodness of fit of the F_2 progeny to the classical genetic ratios. The phenotype classes included several disease rating classes; the grouping of rating classes into a phenotype class was determined by the observation of the modal groups in the F_2 progeny distribution, in conjunction with the observed modal grouping of their parental lines.

Another method of estimating the number of genes was based on the proportion of the parental types recovered in the F_2 generation. The observed number of parental genotypes in the F_2 population was the number F_2 plants producing homozygous F_3 families determined as having both the mean disease rating and the variance of ratings not significantly different from the mean disease rating and variance of the ratings of the parental lines involved in each cross. Labelle, the susceptible parent, was used for these comparisons since Labelle was the common susceptible parent involved in all three crosses. The F statistic was used as a guide to an appropriate cut off point separating apparently homozygous lines from segregating lines.

RESULTS AND DISCUSSION

Comparison of three sheath blight infection evaluation (rating) methods.

The mean ratings of the nine check cultivars and three parental lines for the three evaluation methods for sheath blight infection are presented in Table 1. The table shows the classification of the cultivars based on the field evaluations for sheath blight resistance in disease nurseries conducted at the Rice Research Station in Crowley, in recent years.

For evaluation Method 1, the entries RG94, RG95, Tetep, and Taducan previously classified as resistant had mean disease ratings ranging from 3.48 to 5.15. These ratings were considerably lower than those of the other cultivars. The mean disease ratings of the four cultivars Nortai, Melrose, Saturn, and Nato were similar and varied from 7.05 to 7.57, indicating that the distinction between the previously classified moderately resistant cultivars (Nortai and Melrose) and moderately susceptible cultivars (Nato and Saturn) was not possible in this test. The mean disease ratings of the cultivars Starbonnet, Leah, Lebonnet, and the very susceptible parent Labelle were very similar and within the narrow range of 8.46 to 8.80, indicating that the

Table 1. Mean disease ratings of check cultivars and parental lines for three methods of evaluating sheath blight infection.

Cultivar	Method 1 ¹	Method 2 ²	Method 3 ³	Class of Resistance ⁴	1980 Rating ⁵
RG94	4.00ab ^{6/}	22.85ab	34.55a	R	---
RG95	3.48a	15.76a	29.23a	R	---
Taducan	5.15c	62.26cd	79.80bc	R	2.3
Tetep	4.52bc	42.87bc	71.77b	R	2.0
Nortai	7.25d	69.62de	82.33bc	MR	5.0
Melrose	7.55de	80.12de	88.40bc	MR	---
Saturn	7.57de	72.62de	81.05bc	MS	4.3
Nato	7.05d	74.60de	75.47bc	MS	4.7
Starbonnet	8.46ef	91.41ef	92.76bc	S	7.3
Leah	8.62f	93.25ef	96.77c	S	6.3
Lebonnet	8.80f	94.50ef	97.35c	VS	8.0
Labelle	8.72f	90.75ef	96.92c	VS	8.0

1 - Method 1: Sheath blight ratings based on 0 to 9 rating scale where 0 = healthy plant, no symptoms and 9 = severely infected plants.

2 - Method 2: Sheath blight rating based on visual estimates of sheath area infected expressed in percentage of total sheath area on individual plants.

3 - Method 3: Ratings based on the ratio (in percentage) of lesion total height to the total plant height (from plant base to the collar of uppermost leaf)

4 - Classes of resistance based on previous field evaluations using a 0 to 9 scale. R = resistant, MR = moderately resistant, MS = mod. susceptible, s = susceptible, and vs = very susceptible.

5 - The 1980 Rating was an average rating on three replicated seedling rows placed in the humidity chamber for two weeks.

6 - Means with the same letter are not significantly different (0.05 probability level) for each evaluation method.

difference between the previously classified susceptible varieties (Starbonnet and Leah) and the very susceptible varieties (Lebonnet and Labelle) could not be detected under the conditions of this test.

The disease ratings of all the entries, except the very susceptible cultivars, were higher than those obtained under field conditions, suggesting that sheath blight infection was more severe in this greenhouse test than in the inoculated tests under field conditions. The failure to distinguish between the moderately resistant cultivar class and the moderately susceptible class, or between the susceptible class and that of the very susceptible class was likely due to the high level of sheath blight infection in this test. Previous greenhouse studies have shown that infection ratings of varieties infected under a humidity chamber in the greenhouse for 2 weeks were similar to mature plant ratings from inoculated tests under field conditions. Since the "RG" lines were known to be quite resistant to sheath blight, the plants in this study were allowed to remain under the humidity chamber for a longer period, to provide a more severe test in order to increase the differential disease reaction among the more resistant plants. The results obtained with the check varieties indicated that this objective was achieved. A 2-wk infection period would usually provide a greater differentiation among the more susceptible cultivars and less differentiation among the more resistant cultivars.

Under evaluation Method 2, the estimates of the sheath area infected for the parental lines RG94 and RG95 were lower on the average than those of Taducan and Tetep. The susceptible and the very susceptible varieties had the highest sheath area infected. The disease ratings of these varieties were above 90%. Although there was a large difference between the "RG" lines, and Tetep and Taducan, the lesions formed on these lines were the same type. These lines showed a few small or large lesions, usually distinct with broad-purple margins. Such lesion types are known to occur on resistant varieties. On the "RG" lines, the lesions tended to be concentrated on the lower 1/3 of the plants, while on Tetep and Taducan the lesions tended to be concentrated on the lower 3/4 of the plant and were more scattered. The error in estimating the lesion area was much reduced when the lesions were more concentrated (RG lines), and was inflated when the lesions were scattered (Taducan and Tetep). On cultivars with intermediate levels of resistance (Nortai, Melrose, Saturn, and Nato), the lesions mainly developed on the lower 4/5 of the leaf sheath area, were sometimes scattered, although usually coalesced. On the susceptible cultivars the lesions were coalesced and continuous over the entire sheath area. The percent sheath area infected was much easier to estimate precisely on the plants of susceptible cultivars.

Under evaluation Method 3, the infection of the parental lines RG94 and RG95 was distinctly lower than that of any other cultivar. All the susceptible and the very susceptible varieties had high disease ratings usually larger than 90%. The consistently low disease ratings on the "RG" lines was attributed to the tendency of the lesions to be concentrated on the lower 1/3 of the plant. The higher ratings of the resistant lines, Tetep and Taducan, was due to the scattering and to the long narrow isolated lesions on the sheath surface rather than to a true susceptible reaction to sheath blight. The higher disease ratings encountered in Method 3 were due to the fact that only the lesion length, as opposed to the lesion area in Method 2, was considered. Narrow lesions spreading upwards along the leaf sheath contributed to the large increase in the ratings from Method 3 compared to Method 2.

It was evident that rating sheath blight infection on resistant cultivars may not be done precisely without some subjective evaluation of plant reaction such as considering the lesion type and visually estimating the lesion area. The implications of the sheath blight infection ratings for the check cultivars and the parental lines on the evaluation of the F_1 and F_2 progenies were, that under the conditions of this test, the infection of sheath blight was severe, and the distribution of the F_1 and F_2 plants would be skewed towards susceptible ratings. However, due to the severity of the test, the occurrence of escapes would be less likely.

Inheritance of sheath blight resistance in the "RG" dwarf rice cultivar.

The means of the ratings for the F_1 plants and their parental lines and mid-parental ratings are summarized in Table 2. The mean disease ratings of the F_1 plants were consistently located between the resistant parent and the mid-parental values and were close to the value of the resistant parent. These data indicated that resistance to sheath blight disease in the "RG" lines was governed by dominant or nearly dominant genes.

The number of F_2 plants in each sheath blight rating class for evaluation Method 1 are given in Table 3. The F_2 progenies gave a somewhat indistinct to distinct bimodal distribution with a modal peak at classes 4 and 5, with a slight drop at class 6 and another modal peak at class 7. The modes of all the F_2 populations were outside the range of the susceptible parent (Labelle). The distribution of the F_2 progenies under the second evaluation method is presented in Table 4. The data from each cross showed a similar bimodal distribution pattern. The two modes in each F_2 distribution did not match that of the parental lines. The mode of the most resistant group was within the range of the resistant parental distribution, but was shifted towards the susceptible reaction. The second mode was the same for the three crosses and was found at class 70, outside the distribution of the susceptible parent. Inspection of the F_2 distributions in the second modal class indicated the possibility of a smaller third mode that was not sharply distinguished from the second. This third mode occurred within the range of the susceptible parent (Labelle) and was located at class 90 or 95. The discrepancy between the F_2 distributions under Method 1 and Method 2 appeared to be due to the number of sheath blight infection rating classes. With 20 classes in Method 2, further discrimination between the levels of resistance in F_2 population was possible; whereas Method 1 was restricted to 10 classes which did not always allow a clear separation of plants with different levels of resistance. However, Method 1 allowed a clear separation of the resistant check cultivars from the moderately resistant and the susceptible cultivars, and also the plants could be rated approximately two times faster than when using Method 2. Therefore, much less labor and time was required to complete this evaluation.

One procedure for estimating the number of genes controlling resistance to sheath blight was based on the number of probable parental genotypes recovered in the F_2 generation. This number was determined by comparing the phenotypes of Labelle (the common susceptible parental line in the three crosses) with the F_3 families. The F_3 families which were not significantly different from Labelle in mean disease ratings and variance were considered to be genetically similar to the Labelle parent, as would be their F_2 parent plant.

Table 2. Mean sheath blight infection ratings of the parental lines and the F_1 progenies for evaluation Methods 1, 2, and 3.

Cross	Line	Method ¹		
		1	2	3
RG93 x Labelle	Labelle	8.72	90.75	96.92
	RG93	----	-----	-----
	F_1	3.58	23.78	30.66
RG94 x Labelle	Labelle	8.72a ²	90.75a	96.92a
	RG94	4.00b	22.85b	34.55b
	mid-parent	6.36-	56.80-	65.73-
	F_1	4.42b	26.42b	40.35b
Labelle x RG95	Labelle	8.72a	90.75a	96.92a
	RG95	3.48b	15.76b	29.23b
	mid-parent	6.10-	53.22-	63.07-
	F_1	4.22b	33.50b	35.22b

1) Method 1: sheath blight ratings based on 0 to 9 rating scale where 0 = healthy plant, no symptoms, and 9 = severely infected plant.

Method 2: sheath blight ratings based on visual estimate of the percentage of sheath area infected.

Method 3: sheath blight ratings based on the ratio (in percentage) of lesion total height to total plant height.

2) Means with the same letter are not significantly different (0.05 probability level) for each evaluations method.

Table 3. Distribution of the plants from the parental lines and their F_1 and F_2 progenies evaluated for sheath blight infection under rating Method 1¹.

Cross	Parent line or progeny	Class										$\bar{X}$	N	σ^2
		0	1	2	3	4	5	6	7	8	9			
RG93 x Labelle	Labelle	-	-	-	-	-	-	1	---	8	31	40	8.72	0.35
	RG93 ²	-	-	-	-	-	-	-	---	---	---	---	---	---
	F_1	-	-	1	3	8	-	-	---	---	---	12	3.58	0.44
	F_2	-	-	2	14	6	65	57	121	47	33	399	6.19	2.64
RG94 x Labelle	Labelle	-	-	-	-	-	-	1	---	8	31	40	8.72	0.35
	RG94	-	-	3	6	23	4	4	---	---	---	40	4.00	0.97
	F_1	-	-	-	1	9	3	-	---	1	---	14	4.42 ³	1.34 ³
	F_2	-	-	3	16	80	79	71	93	38	19	399	5.81	2.49
Labelle x RG95	Labelle	-	-	-	-	-	-	1	---	8	31	40	8.72	0.35
	RG95	-	1	4	16	15	1	-	2	---	---	39	3.48	1.30
	F_1	-	-	-	2	5	1	-	1	---	1	10	4.22 ⁴	1.44 ⁴
	F_2	-	-	4	14	69	86	40	79	41	19	352	5.81	2.71

1 Sheath blight infection method 1 used a 0-9 scale where 0 = a healthy plant, no symptoms and 9 = a severely infected plant.

2 The RG93 parent line was lost and not available for the test.

3 The mean and variance without one abnormal plant were 4.15 and 0.30.

4 The mean and variance without two abnormal plants were 3.87 and 0.41.

Table 4. Distribution of plants from the parental lines and their F_1 and F_2 progenies evaluated for sheath blight infection under rating Method 2¹

Cross	Parent line or progeny	Class																			$\bar{X}$	N	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
RG93 x Labelle	Labelle	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	5	4	5	9	14	40	90.75	136.60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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1 In sheath blight infection rating method 2, infection classes represent the percent of sheath area of a plant infected.

2 The RG93 line was lost and not available for testing.

3 The means and variance without one abnormal plant were 23.07 and 149.07.

4 The mean and variance without two abnormal plants were 19.37 and 24.55.

For data from sheath blight rating Method 1, the estimates of the number of probable parental genotypes recovered were all between the expected number for two or three genes and was close to the number expected if three genes for resistance to sheath blight were operating in the "RG" lines. For sheath blight evaluation Method 2, the number of observed parental types recovered was very close to the number expected if three genes controlled resistance to sheath blight in the "RG" lines. Using the estimation of the number of genes based on the number of probable parental genotypes recovered, suggests that the resistant "RG" lines and the variety Labelle have different genes for resistance to sheath blight at three independent loci.

The second procedure for estimating the number of genes controlling resistance to sheath blight was based on chi-square evaluation of goodness of fit of F_2 progenies to classical genetic ratios. The distribution of the F_2 progeny from the RG lines x Labelle crosses were only slightly bimodal. Based on this bimodal distribution of the F_2 progeny and the distribution of the parental populations, the break between the resistant phenotype mode and the more susceptible phenotypes was between the infection classes 5 and 6. The F_2 progeny best fit 9:7, 27:37, and 81:175 ratios (Table 5). These results from the 0 to 9 rating method suggest two to four genes control the resistance to sheath blight in the "RG" lines.

The modal groups in each of the F_2 progeny distributions in conjunction with the distributions of their parental lines were used to identify the separation points for the phenotypic classes of resistance (in F_2) which were then fitted to the classical genetic ratios. The rating classes between the resistant modal peak and the moderately resistant-susceptible modal peak with the least number of plants were the rating classes 45 and 50. Therefore, all plants rated 45 or less were considered to have a very resistant phenotype similar to the phenotype of the resistant parent and all plants rated 50 or more were considered to be of the moderately to highly susceptible phenotype and were considered to be phenotypically different from the resistant parent. Similarly, the boundary between the intermediate phenotypic class (moderately resistant and moderately susceptible) with a mode at class 70 and the susceptible phenotypic class, with a mode at 90 or 95, appeared to occur at class 85. Therefore, the very resistant phenotype was assigned all rating classes 5 to 45, the intermediate phenotype was assigned the rating classes 50 to 85, and the susceptible phenotype was assigned classes 90 to 100. The number of plants observed under the three modes were fitted to the phenotypic ratios 9:6:1, 27:27:10, 27:30:7, 27:33:4, and 27:36:1. Table 6 shows the chi-square evaluations of the goodness of fit of the observed F_2 distributions to these genetic ratios.

The fit to the two class model ratio of 27:37 gave chi-square probability ranges of 0.05 to 0.10, 0.025 to 0.05, and 0.10 to 0.25, respectively, for the crosses involving the resistant parental lines RG93, RG94, and RG95. Likewise, the fit to the three phenotype model to the expected genetic ratio 27:30:7 gave a probability level of 0.25 to 0.50, 0.10 to 0.25, and less than 0.005 and fit the ratio 27:33:4 with probabilities of less than 0.005, 0.010 to 0.025, and 0.10 to 0.25 for the F_2 progenies having the resistant parental lines RG93, RG95, and RG94, respectively.

Table 5. Chi-square evaluation of goodness of fit of the F_2 progeny to phenotypic genetic ratios when plants were rated using the 0-9 rating method (Method 1).

Cross	Phenotypic Ratios ¹ R: (I+S) ²	Observed F_2 Phenotypes R: (I+S) ²	Probability of χ^2 statistics
RG93 x Labelle (n=399)	3:1	141:258	<.005
	9:7	141:258	<.005
	27:37	141:258	0.005 - 0.010
	81:175	141:258	0.10 - 0.250
RG94 x Labelle (n=399)	3:1	178:221	<.005
	9:7	178:221	<.005
	27:37	178:221	0.25 - 0.500
	81:175	178:221	<.005
Labelle x RG95 (n=352)	3:1	173:179	<0.005
	9:7	173:179	0.005 - 0.010
	27:37	173:179	0.005 - 0.010
	81:175	173:179	<0.005

- 1) 3:1 is a one locus ratio ; 9:7 is a two loci ratio ; 27:37 is a three loci ratio ; 81:175 is a four loci ratio.
- 2) The resistant phenotype (R) included rating classes 0-5; the intermediate and susceptible phenotypes (I+S) included rating classes 6-9.

Table 6. Chi-square evaluation of goodness of fit of the F_2 progeny to phenotypic genetic ratios when plants were rated by estimating percent sheath area infected (Method 2).

Cross	Phenotypic ¹ Ratio R: (I+S) or R:I:S ²	Observed F_2 Phenotypes ² R: (I+S) or R:I:S	Probability from χ^2 statistics
RG93 x Labelle (N=399)	3:1	149:250	<.005
	9:7	149:250	<.005
	9:6:1	149:208:42	<.005
	27:37	149:250	.05-.10
	27:27:10	149:208:42	<.005
	27:30:7	149:208:42	.25-.50
	27:33:4	149:208:42	<.005
	27:36:1	149:208:42	<.005
	81:175	149:250	.10-.025
RG94 x Labelle (N=399)	3:1	188:211	<.005
	9:7	188:211	<.005
	9:6:1	188:189:22	<.005
	27:37	188:211	.025-.05
	27:27:10	188:189:22	<.005
	27:30:7	188:189:22	<.005
	27:33:4	188:189:22	.10-.25
	27:36:1	188:189:22	<.005
	81:175	188:211	<.005
Labelle x RG95 (N=352)	3:1	137:215	<.005
	9:7	137:215	<.005
	9:6:1	137:181:34	<.005
	27:37	137:215	.10-.25
	27:27:10	137:181:34	<.005
	27:30:7	137:181:34	.10-.25
	27:33:4	137:181:34	.010-.025
	27:36:1	137:181:34	<.005
	81:175	137:215	<.005

1 3:1 is a one locus ratio; 9:7 and 9:6:1 are two loci ratios, 27:37, 27:27:10, 27:30:7, 27:33:4, and 27:36:1 are three loci ratios; 81:175 is a four loci ratio.

2 The resistant phenotype (R) included rating classes 5-45%; the intermediate phenotype (I) including rating classes 50-80%; and the susceptible phenotype (S) include rating classes 90-100%.

Although the chi-square probability levels were small for the fit of the F_2 progenies to the ratio 27:37, this along with the good fit to 27:30:7 and 27:33:4 suggested that at least three independently inherited dominant genes were governing resistance to sheath blight in the "RG" lines. This result was in agreement with the number of genes estimated by the parental recovery method. Apparently at least one dominant resistant gene must be present, at each of the three loci, to produce a resistance level equivalent to that of the homozygous "RG" lines.

SUMMARY AND CONCLUSIONS

The use of lesion height was not a satisfactory method of measuring sheath blight infection on rice plants. However, a 0 to 9 rating, based on lesion type and estimated percent sheath area infected, did effectively differentiate between resistant, intermediate, and susceptible plants and was the least time consuming method. A method based on careful measurement of percent sheath area infected, while time consuming, did give a more precise measurement and separation between levels of resistance.

The results from the study of the inheritance of the sheath blight resistance of the "RG" dwarf rice line, indicated that sheath blight resistance is dominant to susceptibility. The high level of resistance observed in the "RG" lines, compared to the susceptible variety Labelle, appears to be controlled by three, independently inherited, dominant genes.

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FUNGICIDAL CONTROL OF RICE FOLIAR AND STEM DISEASES^{1/}

(A Progress Report)

M.C. Rush, G.D. Lindberg, and D.E. Groth

INTRODUCTION

In field testing of foliar applications of fungicides for the control of diseases caused by fungi was initiated in 1972. Theoretically, the fungus 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 (Helminthosporium 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 L.S.U. Rice Research Station, Crowley, LA, during the 1985 season to screen fungicides for their efficacy in controlling foliar and stem diseases on Saturn 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 repeated six times in a randomized complete block design. The plots in this test were inoculated with Rhizoctonia solani and infections by the target fungi were from this inoculation or from natural sources of inoculum. Five hundred lb/A of 20-10-10 fertilizer was applied by a drill application to the test area at planting. Plots were planted May 11, 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 (July 6), boot (July 17), and heading (August 6) stages of growth. Fungicides were applied in 20 gal/A of water with a back-pack type CO₂ sprayer. The treatments were as indicated in Table 1.

^{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.

Plots were rated for sheath blight, brown spot, narrow-brown spot, and leaf smut incidence 2 days before harvest. The plots were harvested with a small-plot combine on September 7. Rough rice weights were corrected to 12% moisture.

RESULTS AND DISCUSSION

The effects of foliar fungicide sprays on yield and sheath blight control is shown in Table 1. Spraying NTN 19701 75WP at the boot stage followed by Benlate 50WP at heading gave a 1,274 lb/A yield increase over the inoculated, unsprayed plots. Disease control was excellent with this treatment. Other treatments giving significant disease control and yield increases included Tilt 3.6E at the green ring and boot stages followed by a heading application of Benlate 50WP, SN84364 50WP at the green ring and boot stages, NTN 19701 75WP plus HWG 1608 1.2EC at the green ring and boot stages, NTN 19701 at boot and heading, Rovral 50WP at boot and heading, CGA-453 at boot and heading, Mertect 340-F at boot and heading, and DPX-965 50DF at boot and heading. The fungicides giving good sheath blight control increased yield by about 400 to 1,200 lb/A.

Control of narrow brown spot, leaf smut, and brown spot by the test fungicides tested gave significant control of narrow brown spot and leaf smut. CGA-453, DPX-H6573, Prochloraz 40SC, and HWG 1608 1.2EC gave complete control of these two diseases. Only Rovral 50WP, CGA-453, CGA-449, and DPX-H6573 gave significant control of the brown spot disease.

DPX-H6573 and CGA-453 gave significant control of all four of the disease monitored.

Table 1. Effect of fungicidal sprays on yield and disease control in Lemont rice inoculated with *Rhizoctonia solani*. Rice Research Station, Crowley, La. 1985.

	Timing ^a	Rate (lb or pt/A formulated)	Mean Yield (lb/A)	Change from unsprayed (lb/A)	Mean disease rating ^c (0-9)	Mean % tillers infected	Mean % tillers dead
NTN 19701 75WP, Benlate 50WP	B,H	0.35 lb, 1.0 lb	6985**	1274	2.6**	17.8**	0.0**
TILT 3.6E, Benlate 50WP	GR+B,H	6 fl-oz (0.38), 1.0 lb	6878**	1167	2.8**	35.6**	2.2**
SN84364 50WP	GR+B	1.0 lb	6878**	1167	3.0**	16.2**	0.5**
NTN 19701 75WP + HWG 1608 1.2EC	GR+B	0.35 lb + 0.75 pt	6766*	1055	2.4**	10.8**	0.0**
NTN 19701 75WP	B+H	0.35 lb	6760*	1049	2.6**	16.2**	0.0**
Untreated--uninoculated	-	-	6743*	1032	2.4**	25.0**	7.0**
ROVRAL 50WP	B+H	2.0 lb	6730*	1019	2.6**	25.4**	0.0**
NTN 19701 75WP, HWG 1608 1.2EC	GR,B	0.35 lb, 1.5 pt	6717*	1006	2.4**	12.0**	0.0**
SN84364 50WP + oil	GR+B	0.5 lb + 1 qt	6715*	1004	3.6**	36.0**	4.7**
NTN 19701 75WP	B+H	0.5 lb	6708*	997	3.2**	21.4**	1.0**
CGA-453	B+H	1.0 lb	6640*	929	1.2**	9.6**	0.0**
MERTECT 340-F	B+H	0.75 pt	6590*	879	4.6**	53.4**	11.0**
DPX-965 50DF	B+H	1.01 lb	6588*	877	3.2**	31.2**	3.0**
HWG 1608 1.2EC	B+H	1.5 pt	6543	832	3.2**	35.8**	2.0**
TILT 3.6E, Benlate 50WP	GR,H	8 fl-oz (0.5 pt), 1.0 lb	6496	785	3.8**	37.0**	9.0**
SN84364 50WP + oil	GR+B	0.7 lb + 1 qt	6476	765	3.8**	21.6**	5.0**
SN84364 50WP	GR+B	0.7 lb	6438	727	3.0**	24.4**	1.2**
Benlate 50WP	B+H	1.0 lb	6409	698	4.6**	52.6**	10.0**
A-1055 10EC	B+H	2.0 pt	6390	679	2.8**	18.6**	0.2**
CGA-449 50WP	B+H	0.5 lb	6388	677	3.6**	26.2**	2.7**
CGA-449 50WP	B+H	1.0 lb	6354	643	1.8**	15.8**	0.0**
ROVRAL 50WP + Nufilm 17	B,H	1.0 + 0.5 (19.2 ml/gal)	6304	593	4.4**	51.6**	10.5**
ROVRAL 50WP	B+H	1.0 lb	6287	576	3.8**	41.8**	7.0**
DPX-H6573	B+H	1.0 pt	6283	572	1.8**	29.4**	0.0**
TILT 3.6E	GR+B	8 fl-oz (0.5 pt)	6227	516	3.2**	30.0**	2.0**
NTN 19701 75WP + HWG 1608 1.2EC	B+H	0.35 lb + 1.5 pt	6201	490	2.4**	11.6**	0.0**
A-1055 15WP	B+H	2.0 lb	6147	436	2.8**	34.4**	0.5**
DPX-965 50DF	GR+B	1.0 lb	6143	432	5.4	57.2**	21.0**
PROCHLORAZ 40SC	B+H	1.25 pt	6121	410	4.6**	58.6*	11.5**
ROVRAL 50WP, Benlate 50WP	B,H	1.0 lb, 1.0 lb	6111	400	5.0**	54.0**	12.0**
CGA-449 50WP	B+H	0.75 lb	6096	385	3.0**	28.8**	2.2**
NC28410 40SC	GR+B	5.0 pt	6078	367	5.8	67.6	22.0**

CONTINUED.

Table 1. Cont.

	Timing ^a	Rate (lb or pt/A formulated)	Mean Yield (lb/A)	Change from unsprayed (lb/A)	Mean disease rating ^c (0-9)	Mean % tillers infected	Mean % tillers dead
TILT 3.6E	GR+B	6 fl-oz (0.38 pt)	6016	305	4.4**	47.8**	11.0**
RH-4056 50WP	B+H	2.0 lb + 4.8 ml/gal CS-7	5935	224	6.0	78.2	29.4
RH-4056 50WP	B+H	0.5 lb + 4.8 ml/gal CS-7	5891	180	6.4	69.2	26.0
Unsprayed-inoculated	-	-	5711	-	6.6	81.4	34.0
RH-4056 50WP	GR+B	1.0 lb + 4.8 ml/gal CS-7	5558	(-) 153	7.0	76.6	39.0
NC28410 40SC	GR+B	2.5 pt	5546	(-) 165	6.0	77.2	25.5
RH-4056 50WP	GR+B	2.0 lb + 4.8 ml/gal CS-7	5528	(-) 183	7.0	75.2	37.0
RH-4056 50WP	B+H	1.0 lb + 4.8 ml/gal CS-7	5416	(-) 296	6.2	74.4	28.0
LSD 5%			864.8		1.3	18.2	9.0
1%			1141.6		1.7	24.0	11.4

^a Sprays were applied at the indicated rate in 20 gallons water per acre at green ring (GR), boot (B) and heading (H).

^b To Convert from lb/A to kg/ha, multiply by 1.12.

^c Ratings based on a scale of 0 = no disease and 9 = severe disease.

^d Means followed by asterisks were significantly different from the unsprayed control at 1% (**) or 5% (*) level.

Table 2. Effect of fungicidal sprays on yield and disease control in Lemont rice naturally infected with Cercospora oryzae, Entyloma oryzae, and Helminthosporium oryzae. Rice Research Station, Crowley, LA. 1985.

	Timing ^a	Rate (lb or pt/A formulated)	Cercospora		Entyloma		Helminthosporium	
			oryzae ^c rating	oryzae ^c rating	oryzae ^c rating	oryzae ^c rating	oryzae ^c rating	oryzae ^c rating
NTN 19701 75WP, Benlate 50WP	B,H	0.35 lb, 1.0 lb	0.6**	2.2			3.8	
TILT 3.6E, Benlate 50WP	GR+B,H	6 fl-oz (0.38), 1.0 lb	0.4**	0.0**			4.0	
SN84364 50WP	GR+B	1.0 lb	2.8**	0.2**			4.2	
NTN 19701 75WP + HWG 1608 1.2EC	GR+B	0.35 lb + 0.75 pt	1.2**	0.2**			3.6	
NTN 19701 75WP	B+H	0.35 lb	3.0**	1.4**			3.8	
Untreated--uninoculated	-	-	4.8	3.6			4.2	
ROVRAL 50WP	B+H	2.0 lb	4.4	1.8*			2.2**	
NTN 19701 75WP, HWG 1608 1.2EC	GR,B	0.35 lb, 1.5 pt	1.6**	0.2**			4.2	
SN84364 50WP + oil	GR+B	0.5 lb + 1 qt	2.8**	0.2**			3.6	
NTN 19701 75WP	B+H	0.5 lb	0.6**	0.6**			3.8	
CGA-453	B+H	1.0 lb	0.0**	0.0**			0.8**	
NERTECT 340-F	B+H	0.75 pt	2.2**	3.0			4.2	
DPX-965 50DF	B+H	1.01 lb	0.6**	1.8*			3.8	
HWG 1608 1.2EC	B+H	1.5 pt	1.6**	0.0**			3.4	
TILT 3.6E, Benlate 50WP	GR,H	8 fl-oz (0.5 pt), 1.0 lb	0.2**	0.0**			4.0	
SN84364 50WP + oil	GR+B	0.7 lb + 1 qt	2.8**	0.4**			4.4	
SN84364 50WP	GR+B	0.7 lb	2.0**	0.2**			3.2	
Benlate 50WP	B+H	1.0 lb	0.4**	2.6			4.0	
A-1055 10EC	B+H	2.0 pt	0.8**	0.4**			3.4	
CGA-449 50WP	B+H	0.5 lb	2.5**	1.5**			3.4	
CGA-449 50WP	B+H	1.0 lb	3.2**	2.4			2.8**	
ROVRAL 50WP + Nufilm 17	B+H	1.0 + 0.5 (19.2 ml/gal)	3.8*	1.8*			2.2**	
ROVRAL 50WP	B+H	1.0 lb	4.0	1.4**			2.6	
DPX-H6573	B+H	1.0 pt	0.0**	0.0**			1.2**	
TILT 3.6E	GR+B	8 fl-oz (0.5 pt)	0.4**	0.0**			4.2	
NTN 19701 75WP + HWG 1608 1.2EC	B+H	0.35 lb + 1.5 pt	0.0**	0.0**			3.0	
A-1055 15WP	B+H	2.0 lb	1.2**	0.0**			3.4	
DPX-965 50DF	GR+B	1.0 lb	2.0**	2.4			4.2	
PROCHLORAZ 40SC	B+H	1.25 pt	0.0**	0.0**			3.2	
ROVRAL 50WP, Benlate 50WP	B,H	1.0 lb, 1.0 lb	0.0**	0.2**			4.4	
CGA-449 50WP	B+H	0.75 lb	2.2**	3.0			4.0	
NC28410 40SC	GR+B	5.0 pt	4.0	0.6**			3.6	

CONTINUED.

Table 2. Cont.

	Timing ^a	Rate (lb or pt/A formulated)	Cercospora		Entyloma		Helminthosporium	
			oryzae	c	oryzae	c	oryzae	c
			rating		rating		rating	
TILT 3.6E	GR+B	6 fl-oz (0.38 pt)	1.6**		0.2**		3.6	
RH-4056 50WP	B+H	2.0 lb + 4.8 ml/gal CS-7	2.4**		0.8**		4.4	
RH-4056 50WP	B+H	0.5 lb + 4.8 ml/gal CS-7	1.0**		0.2**		4.0	
Unsprayed-inoculated	-	-	5.6		3.2		4.4	
RH-4056 50WP	GR+B	1.0 lb + 4.8 ml/gal CS-7	4.0		0.8**		3.8	
NC28410 40SC	GR+B	2.5 pt	3.0**		0.8**		3.4	
RH-4056 50WP	GR+B	2.0 lb + 4.8 ml/gal CS-7	4.0		1.0**		3.6	
RH-4056 50WP	B+H	1.0 lb + 4.8 ml/gal CS-7	2.4**		1.2**		4.6	
LSD 5%			1.6		1.3		1.4	
1%			2.2		1.8		1.8	

^a Sprays were applied at the indicated rate in 20 gallons water per acre at grain ring (GR), boot (B) and heading (H).

^b To convert from lb/A to kg/ha, multiply by 1.12.

^c Ratings based on a scale of 0 = no disease and 9 = severe disease. Ratings for C. oryzae, E. oryzae, and H. oryzae were compared statistically to the ratings of the uninoculated control.

^d Means followed by asterisks were significantly different from the unsprayed control at 1% (**) or 5% (*) level.

CHEMICAL CONTROL OF RICE SEEDLING DISEASES - 1985^{1/2/}

(A Progress Report)

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 fungicide 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 cooperative program to develop more effective fungicidal seed treatments is conducted at experiment stations in Arkansas, Louisiana, Mississippi, and Texas. Fungicides or formulations of fungicides are field screened in experimental tests at each station. Those formulations performing well in the experimental tests are advanced to the cooperative tests in subsequent years.

MATERIALS AND METHODS

Cooperative tests. A single lot of Labelle rice seed was treated in February and the first week in March 1985 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 15 minutes. Treated seed were stored in heavy manila seed envelopes until planted.

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- ^{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.
- ^{2/} This research supported in part by funds provided by rice producers through the Louisiana Rice Research Board.

Table 1. Fungicides used in the 1985 plantings of the advanced (cooperative) seed-protectant fungicide tests at the Rice Research Station, Crowley, LA.

Fungicide or combination	Rate (oz or fl oz/cwt formulated)	Manufacturer or supplier
Apron 25W + Imazalil/TCTMB	2.0 + 2.0	Wilbur-Ellis
Captan 65 Sprills	2.5	Stauffer
Dithane F-45	6.0	Rohm & Haas
NC 28410 40SC + Captan 65 Sprills	4.5 + 2.5	Nor-Am
TF3675 + Captan 65 Sprills	4.0 + 2.5	Chipman
TF3675 + Captan 65 Sprills	2.0 + 2.5	Chipman
Vitavax 200 FF	4.0	Gustafson

Four pounds of seed were treated with each fungicide. Treated seed samples were divided into 1-lb lots and used in the regional seed-protectant-fungicides test. Seed lots were treated by Dr. Fleet Lee. Tests were planted at the Texas A & M University Agricultural Research and Extension Center at Beaumont, Texas; the Rice Experiment Station, Stuttgart, Arkansas; the Delta Branch Experiment Station, Stoneville, Mississippi; and the Rice Research Station at Crowley, Louisiana.

Simulated water- and drill-seeded methods were used to plant treated seed at the Rice Research Station, Crowley, LA. Water-seeded tests consisted of 12 treatments with six replications of 200 presoaked seeds per plot. Seed were soaked in five volumes of tap water for 30 to 36 hours before planting. Plots consisted of cylinders 2 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 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 water 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 single 10-ft rows with 200 seed per row. Plots were replicated six 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 needed to provide optimum conditions for growth. Stand counts were made when seedlings within a test were at the 3-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.

Experimental tests. One-half pound samples of Foundation Lemont seed from the Rice Research Station were treated with the 59 experimental fungicide treatments listed in Table 2. The treatment procedure was the same as that used for the cooperative tests. Treated seed were water- and drill-seeded at the Rice Research Station, Crowley, LA. Procedures for the experimental water seeded tests were similar to the regional test except that 50 seeds per plot in 1-ft diameter rings were used in the water-seeded tests. Five replicates were used with each planting method at each planting date. The soil pH in these tests was approximately 6.0.

RESULTS AND DISCUSSION

Advanced tests. Data from the drill-seeding of the advanced seed-protectant fungicide test are listed in Table 3. None of the treatments produced a significant increase in stand over the untreated seeds. Percent stand was high in all treatments in this test due to the good weather occurring during the test period.

In the water-seedings of the advanced tests, all fungicide treatments gave significant stand increases over the stand produced by untreated seeds (Tables 4 and 5). Water-seeding gives more severe disease pressure than drill-seeding. Dithane F-45 was among the best treatments in all three water management systems. NU-Gro M was an outstanding treatment in both water-seeded tests.

Experimental tests. None of the fungicide treatments produced significantly improved stands over the untreated seeds in the drill-seeded test (Table 6). In the water-seeded, drained, and flushed test, nine fungicide treatments gave significant stand increases over that produced by untreated seed (Table 7). The Kocide SD, Kocide Maneb, and Kocide Zinc treatments were outstanding in this test. The Kocide Maneb + Kocide Zinc (6.0 + 5.0 fl oz/cwt) treatment increased the stand by 67% over that produced by the untreated seeds.

In the water-seeded, continuous flood test, 44 of 59 fungicide treatments gave significant stand increases when compared to the stand produced by untreated seeds (Table 8). The Kocide and Dithane treatments were outstanding in this test. The Kocide Maneb (8 fl oz/cwt) treated seeds gave a 58% increase in stand over the untreated seeds. This treatment gave an 81% stand. In both water-seeded tests the Kocide and Dithane treatments were outstanding. The Dithane and Kocide treatments were also near the top in the drill-seeded test, although none of the stands from fungicide treated seeds were significantly greater than the stand produced by untreated seeds.

Table 2. Experimental fungicides used in the 1985 experimental seed-protectant fungicide tests at the Rice Research Station, Crowley, LA.

Fungicide or combination	Rate (oz or fl oz/cwt formulated)	Manufacturer or supplier
Untreated seeds	---	---
A 1055 15WP	2.0	Uniroyal
A 1055 15WP	4.0	"
A 1055 15WP	6.0	"
A 1055 15WP	10.0	"
A 1055 15WP + Apron 25W	4.0 + 2.0	"
A 1055 15WP + Apron 25W	6.0 + 2.0	"
Apron 25W	2.0	Gustafson
Apron F1	0.75	Gustafson
Apron 25W + Imazalil/TCMTB	2.0 + 2.0	Wilbur-Ellis
Captan 400 D	2.0	Gustafson
Captan 400 D	3.0	Gustafson
Dithane M-45	4.0	Rohm & Haas
Dithane M-45	6.0	"
Dithane FZ	4.0	"
Dithane FZ	6.0	"
DPX-965 50DF	2.0	Dupont
DPX-965 50DF	4.0	"
DPX-965 50DF	6.0	"
DPX-965 50DF + Apron 25W	4.0 + 2.0	"
DPX-965 50DF + Apron 25W	6.0 + 2.0	"
GUS 4002 2 F1	1.5	Gustafson
GUS 4044 25W	4.0	"
GUS 4044 25W	10.0	"
GUS 4551 F1	1.0	"
GUS 4551 F1	2.0	"
Imazalil/TCMTB	2.0	Wilbur-Ellis
Imazalil/TCMTB	4.0	Wilbur-Ellis
Kocide SD	5.0	Kocide
Kocide SD	10.0	"
Kocide Maneb	6.0	"
Kocide Maneb	8.0	"
Kocide Zinc	5.0	"
Kocide Zinc	10.0	"
Kocide SD + Kocide Maneb	3.0 + 3.0	"
Kocide SD + Kocide Maneb	4.0 + 4.0	"
Kocide SD + Kocide Zinc	5.0 + 5.0	"
Kocide SD + Kocide Zinc	8.0 + 5.0	"
Kocide SD + Kocide Zinc	10.0 + 5.0	"
Kocide Maneb + Kocide Zinc	6.0 + 5.0	"
Kocide SD + K-Maneb + K-Zinc	3.0 + 3.0 + 5.0	"
NC28410	6.0	Nor-Am
NC28410	8.0	"

CONTINUED.

Table 2. CONTINUED.

Fungicide or combination	Rate (oz or fl oz/cwt formulated)	Manufacturer or supplier
NC28410	10.0	"
NC28410 + Apron 25W	10.0 + 0.75	"
NC28410 + Apron 25W	10.0 + 2.0	"
Prochloraz 40 SC	4.0	"
Prochloraz 40 SC	6.0	"
SN84364 50W	3.0	"
SN84364 50W	4.5	"
SN84364 50W	6.0	"
SN84364 50W	8.0	"
SN84364 50W	12.0	"
SN84364 50W + Apron 25W	4.5 + 0.75	"
SN84364 50W + Apron 25W	4.5 + 2.0	"
SN84364 50W + Apron 25W	6.0 + 0.75	"
Terrazole 4 F1	3.0	Uniroyal
Terrazole 4 F1	4.0	Uniroyal
Vitavax 200 FF	4.0	Gustafson

Table 3. Louisiana planting of the Cooperative seed-protectant fungicide test. (Drill-seeded on April 19, stand counts on May 23, 1985.)
Rice Research Station, Crowley, LA.

Treatment	Rate (oz or fl oz/cwt) formulated)	Rep (stand counts)					Mean ^a / Stand	% Change from control	% Stand
		I	II	III	IV	V			
Dithane F-45	6	128	132	151	160	130	140.2	6.5	70.1
Apron 25 W + Imazalil/TCMTB	2 + 2	121	142	150	151	128	138.4	5.2	69.2
Captan 65 Sprills	2.5	121	140	138	147	144	138.0	4.9	69.0
SN84364 50W + Captan 65 Sprills	4.5 + 2.5	132	147	135	127	146	137.4	4.4	68.7
NC28410 40SC + Captan 65 Sprills	10 + 2.5	121	131	147	138	142	135.8	3.2	67.9
TF3675 + Captan 65 Sprills	4 + 2.5	134	148	126	135	134	135.4	2.9	67.7
Untreated Check (Control)	---	131	140	139	125	123	131.6	0.0	65.8
TF3675 + Captan 65 Sprills	2 + 2.5	124	131	130	121	136	128.4	-2.4	64.2
NU-Gro M	6	123	107	125	134	150	127.8	-2.9	63.9
Vitavax 200 FF	4	127	118	144	104	132	125.0	-5.0	62.5
LSD .05							NS		

^a/ Mean number of plants from 200 seeds per plot. Means followed by asterisks were significantly different from the mean for untreated seeds at the 1% (**) or 5% (*) level.

Table 4. Louisiana planting of the Cooperative seed-protectant fungicide test. (Water-seeded on April 19, drained in 3 days, and flushed as needed, stand counts on May 23, 1985.) Rice Research Station, Crowley, LA.

Treatment	Rate (oz or fl oz/cwt) formulated	Rep (stand counts)						Mean ^{a/}	% Change from control	% Stand
		I	II	III	IV	V	VI			
NU-Gro M	6	122	124	101	146	115	101	118.2**	50.2	59.1
NC28410 40 SC + Captan 65 Sprills	10 + 2.5	127	106	121	126	119	98	116.2**	47.7	58.1
TF3675 + Captan 65 Sprills	2 + 2.5	120	102	118	112	115	105	112.0**	42.3	56.0
Dithane F-45	6	112	123	86	121	112	106	110.0**	39.8	55.0
Captan 65 Sprills	2.5	118	112	116	107	89	117	109.8**	39.5	54.9
Vitavax 200 FF	4	112	105	102	114	116	103	108.7**	38.1	54.4
SN84364 50W + Captan 65 Sprills	4.5 + 2.5	90	117	103	112	110	116	108.0**	37.2	54.0
TF3675 + Captan 65 Sprills	2.5	108	101	104	96	119	106	105.7**	34.3	52.9
Apron 25W + Imazalil/TOMTB	2 + 2	93	104	79	107	97	96	96.0*	22.0	48.0
Untreated Check (Control)	---	75	78	84	72	81	82	78.7	0.0	39.4
LSD .05								12.1		
LSD .01								21.1		

^{a/} Mean number of plants from 200 seeds per plot. Means followed by asterisks were significantly different from the mean for untreated seeds at the 1% (**) or 5% (*) level.

Table 5. Louisiana planting of the Cooperative seed-protectant fungicide test. (Water-seeded on April 19, continuous flood, stand counts on May 23, 1985.) Rice Research Station, Crowley, LA.

Treatment	Rate (oz or fl oz/cwt) formulated)	Rep (stand counts)						Mean ^{a/}	% Change from control	% Stand
		I	II	III	IV	V	VI			
TF3675 + Captan 65 Sprills	4 + 2.5	114	123	112	98	125	115	114.5**	71.4	57.3
Dithane F-45	6	122	118	113	91	118	101	110.5**	65.4	55.3
NU-Gro M	6	90	110	124	112	114	106	109.3**	63.6	54.7
TF3675 + Captan 65 Sprills	2 + 2.5	115	109	133	84	123	81	107.5**	60.9	53.8
SN84364 50W + Captan 65 Sprills	4.5 + 2.5	96	114	113	107	89	97	102.7**	53.7	51.4
Captan 65 Sprills	2.5	91	96	112	99	87	105	98.3**	48.7	46.7
Vitavax 200 FF	4	105	94	94	104	99	88	97.3**	45.7	48.7
NC28410 40SC + Captan 65 Sprills	10 + 2.5	87	137	93	94	81	76	94.7**	41.8	47.4
Apron 25W + Imazilil/TMTB	2 + 2	84	79	94	95	82	94	88.0*	31.7	44.0
Untreated Check (Control)	---	62	89	70	64	58	58	66.8	0.0	33.4
LSD .05								15.1		
LSD .01								26.3		

^{a/} Mean number of plants from 200 seeds per plot. Means followed by asterisks were significantly different from the mean for untreated seeds at the 1% (**) or 5% (*) level.

Table 6. Stand establishment by Lemont seeds treated with experimental fungicides and drill-seeded at the Rice Research Station, Crowley, LA. (Planted on April 19, stand counts on May 23, 1985.)

Treatment	Rate (oz or fl oz/cwt) formulated)	Rep (stand counts)					Mean ^a / V	% Change from control	% Stand
		I	II	III	IV	V			
A 1055 15WP	10	125	124	143	119	141	130.4	0.9	65.2
Kocide Maneb Kocide Zinc	6 + 5	130	144	122	115	137	129.6	0.3	64.8
Untreated	---	108	135	151	131	121	129.2	0.0	64.6
SN84364	6	128	128	138	105	146	129.0	-0.2	64.5
Kocide SD	5	111	124	154	113	141	128.6	-0.5	64.3
Apron 25W + Imazalil/TCMTB	2 + 2	103	114	155	120	141	126.6	-2.0	63.3
Terrazole 4 Fl	4	135	116	131	125	125	126.4	-2.2	63.2
Dithane M-45	4	123	124	130	121	132	126.0	-2.5	63.3
Prochloraz 40 SC	4	129	124	131	98	141	124.6	-3.6	62.3
Dithane FZ	6	108	126	156	125	105	124.0	-4.0	62.0
Kocide Maneb	8	130	111	136	112	128	123.4	-4.5	61.7
Prochloraz 40 SC + Apron	6 + 0.75	89	144	141	107	131	122.4	-5.3	61.2
Apron 25W	2	96	134	122	117	143	122.4	-5.3	61.2
Kocide SD + Kocide Maneb	3 + 3	100	123	144	116	129	122.4	-5.3	61.2
Kocide SD + Kocide Zinc	10 + 5	116	119	129	129	116	121.8	-5.7	60.9
GUS 4044 25W	10	106	138	145	108	112	121.8	-5.7	60.9
Dithane M-45	6	108	114	122	123	141	121.6	-5.9	60.8
DPX-965 50 DF + Apron 25W	6 + 2	101	126	135	111	134	121.4	-6.0	60.7
GUS 4044 25W	4	101	135	124	116	131	121.4	-6.0	60.7
SN84364 + Apron	6 + 0.75	109	140	126	100	130	121.0	-6.4	60.5
GUS 4002 - 2 Fl	1.5	89	125	133	126	132	121.0	-6.4	60.5
Kocide SD + Kocide Maneb	4 + 4	118	132	119	124	111	121.8	-6.5	60.4
GUS 4551 Fl	2	113	125	132	112	122	120.8	-6.5	60.4
Kocide SD	10	120	133	109	126	114	120.4	-6.8	60.2
Dithane FZ	4	108	109	126	128	131	120.4	-6.8	60.2
Captan 400 D	3	95	126	122	125	134	120.4	-6.8	60.2
SN84364 + Apron	4.5 + 2	111	136	104	121	129	120.2	-7.0	60.1
Terrazole 4 Fl	3	106	138	127	107	123	120.2	-7.0	60.1
Kocide Zinc	5	105	124	131	109	131	120.0	-7.1	60.0
Kocide Maneb	6	123	131	118	112	116	120.0	-7.1	60.0
Apron Fl	0.75	103	128	132	101	135	119.8	-7.3	59.9
Vitavax 200 FF	4	123	136	94	127	117	119.4	-7.6	59.7

CONTINUED.

Table 6. CONTINUED.

Treatment	Rate (oz or fl oz/cwt) formulated)	Rep (stand counts)					Mean ^{a/}	% Change from control	% Stand
		I	II	III	IV	V			
A 1055 15 WP	2	138	126	117	104	111	119.2	-7.7	59.6
SN84364 + Apron	4.5 + 0.75	121	106	130	98	140	119.0	-7.9	59.5
NC28410 + Apron 25 WP	10 + 0.75	97	143	142	92	123	119.0	-7.9	59.5
SN84364	8	101	126	145	111	106	117.8	-8.8	58.9
A 1055 15 WP + Apron 25W	6 + 2	111	119	115	117	127	117.8	-8.8	58.9
DPX-965 50 DF	2	104	136	125	102	121	117.6	-9.0	58.8
NC 28410	10	109	153	113	107	106	117.6	-9.0	58.8
Imazalil/TCMTB	2	107	148	106	98	129	117.6	-9.0	58.8
Kocide Zinc	10	116	106	121	118	124	117.0	-9.4	58.5
Prochloraz 40 SC	4	115	139	103	98	130	117.0	-9.4	58.5
A 1055 15 WP	4	96	123	134	108	122	116.6	-9.8	58.3
DPX-965 50 DF	6	115	114	129	105	119	116.4	-9.9	58.2
Kocide SD + Kocide Maneb	3 + 3 + 5	89	124	134	101	132	116.0	-10.2	58.0
+ Kocide Zinc									
Kocide Maneb + Kocide Zinc	8 + 5	108	102	138	97	133	115.6	-10.5	57.8
A 1055 15 WP	6	100	124	148	101	101	114.8	-11.2	57.4
NC28410 + Apron 25 WP	10 + 2	111	145	117	106	95	114.8	-11.2	57.4
SN84364	3	86	132	121	99	136	114.8	-11.2	57.4
NC28410	6	105	114	132	98	125	114.8	-11.2	57.4
Imazalil/TCMTB	4	106	106	131	106	125	114.8	-11.2	57.4
Kocide SD + Kocide Zinc	5 + 5	129	106	105	103	128	114.2	-11.6	57.1
Captan 400 D	2	83	142	97	110	137	113.8	-11.9	56.9
DPX-965 50DF + Apron 25W	4 + 2	102	101	127	110	128	113.6	-12.1	56.8
A 1055 15WP + Apron 25W	4 + 2	119	130	103	104	111	113.4	-12.2	56.7
SN84364	4.5	101	123	99	98	143	112.8	-12.7	56.4
SN84364	12	102	123	114	113	105	111.4	-13.8	55.7
NC28410	8	100	110	125	100	121	111.2	-13.9	55.6
GUS 4551 F1	1	98	122	110	110	114	110.8	-14.2	55.4
DPX-965 50 DF	4	95	121	133	90	112	110.2	-14.7	55.1
LSD .05									
LSD .01									
							NS		

^{a/} Mean number of plants from 200 seeds per plot. Mean followed by astericks were significantly different from the mean for untreated seeds at the 1% (**) or 5% (*) level.

Table 7. Stand establishment by Lemont seeds treated with experimental fungicides and water-seeded and drained at the Rice Research Station, Crowley, LA. (Planted on April 19, stand counts on May 23, 1985.)

Treatment	Rate (oz or fl oz/cwt) formulated)	Rep (stand counts)					Mean ^a / —	% Change from control	% Stand
		I	II	III	IV	V			
Kocide Maneb + Kocide Zinc	6 + 5	41	32	47	48	45	42.6**	64.1	85.2
Kocide Maneb	8	35	46	37	47	41	41.2**	45.1	82.4
Kocide Maneb	6	43	42	38	45	35	40.6**	43.0	81.2
Kocide SD + Kocide Maneb	4 + 4	36	40	42	35	45	39.6**	39.4	79.2
Kocide SD + Kocide Maneb	3 + 3	37	39	36	39	37	37.6**	32.4	75.2
Kocide Maneb + Kocide Zinc	8 + 5	45	39	34	39	29	37.2**	31.0	74.4
Kocide SD + Kocide Zinc	5 + 5	33	37	32	35	36	34.6*	21.8	69.2
Dithane FZ	6	32	34	36	39	32	34.6*	21.8	69.2
Kocide SD	5	31	37	39	29	37	34.6*	21.8	69.2
Kocide SD + Kocide Maneb + Kocide Zinc	3 + 3 + 5	28	40	37	30	36	34.2	20.4	68.4
Terrazole 4 F1	4.0	30	43	36	31	30	34.0	19.7	68.0
SN84364	12	41	34	30	30	34	33.8	19.0	67.6
Dithane M-45	4	33	28	38	33	35	33.4	17.6	66.8
Kocide Zinc	10	39	38	31	24	34	33.2	16.9	66.4
SN84364 + Apron	4.5 + 2	32	34	37	32	31	33.2	16.9	66.4
Kocide SD	10	33	29	40	32	31	33.0	16.2	66.0
NC28410 + Apron 25 WP	10 + 0.75	38	29	33	32	33	33.0	16.2	66.0
Dithane M-45	6	37	40	26	25	32	32.0	12.7	64.0
GUS 4044 25W	10	31	26	33	30	37	31.4	10.6	62.8
Kocide SD + Kocide Zinc	10 + 5	31	32	35	30	29	31.4	10.6	62.8
SN84364	8	29	28	34	27	38	31.2	9.9	62.4
Imazalil/TCMTB	4	32	32	30	29	32	31.0	9.2	62.0
SN84364	6	31	31	34	29	29	30.8	8.5	61.6
Vitavax 200 FF	4	35	33	31	30	25	30.6	8.5	61.6
GUS 4044 25W	4	36	27	28	31	31	30.4	7.8	61.2
Terrazole 4 F1	3	38	27	35	25	27	30.4	7.0	60.8
Prochloraz 40 SC	4	33	32	31	24	30	30.0	5.6	60.0
SN84364	4.5	33	32	31	28	24	29.6	4.2	59.2
NC28410	6	34	23	30	35	26	29.6	4.2	59.2
A 1055 15WP + Apron 25W	6 + 2	36	31	29	27	23	29.2	2.8	58.4
NC28410	10	25	29	29	24	39	29.2	2.8	58.4

CONTINUED.

Table 7. CONTINUED.

Treatment	Rate (oz or fl oz/cwt) formulated)	Rep (stand counts)					Mean ^a / Stand	% Change from control	% Stand
		I	II	III	IV	V			
Dithane FZ	4	34	32	30	26	24	29.2	2.8	58.4
Apron F1	0.75	34	31	32	26	22	29.0	2.1	58.0
Captan 400 D	2	33	27	30	23	32	29.0	2.1	58.0
GUS 4551 F1	1	37	23	34	27	24	29.9	2.1	58.0
DPX-965 50DF + Apron 25W	6 + 2	29	31	31	28	26	29.0	2.1	58.0
NC28410 + Apron 25 WP	10 + 2	30	32	21	31	31	29.0	2.1	58.0
Apron 25W + Imazalil/TCMTB	2 + 2	28	31	25	33	27	28.8	1.4	57.6
A 1055 15WP + Apron 25W	4 + 2	31	33	27	25	26	28.4	0.0	56.8
Untreated	---	31	33	33	21	24	28.4	0.0	56.8
GUS 4002-2F1	1.5	44	26	30	20	22	28.4	0.0	56.8
A 1055 15WP	6	26	32	24	35	23	28.0	-1.4	56.0
DPX-965 50DF + Apron 25W	4 + 2	30	30	30	29	21	28.0	-1.4	56.0
SN84364	3	30	28	33	20	28	27.8	-2.1	55.6
Prochloraz 40 SC	6	27	30	28	27	26	27.6	-2.8	55.2
Apron 25W	2	28	34	25	30	21	27.6	-2.8	55.2
SN84364 + Apron	6 + 0.75	22	31	30	28	27	27.6	-2.8	55.2
A 1055 15WP	4	28	29	24	23	33	27.4	-3.5	54.8
NC28410	8	28	30	27	21	28	26.8	-5.6	53.6
Prochloraz 40 SC + Apron	6 + 0.75	24	30	31	23	25	26.6	-6.3	53.2
Captan 400 D	3	29	25	24	30	25	26.6	-6.3	53.2
SN84364 + Apron	4.5 + 0.75	36	0	36	34	27	26.6	-7.0	52.8
DPX-965 50 DF + Apron 25W	4 + 2	27	30	26	22	27	26.4	-7.8	52.4
GUS 4551 F1	2	19	27	30	28	27	26.2	-7.8	52.4
Kocide Zinc	5	25	27	34	25	20	26.2	-8.5	52.0
Imazalil/TCMTB	2	29	27	30	22	22	26.0	-8.5	52.0
A 1055 15WP	10	26	27	29	22	26	26.0	-11.3	50.4
A 1055 15WP	2	25	25	27	29	21	25.2	-12.0	50.0
DPX-965 50DF	4	29	23	28	19	26	25.0	-18.3	46.4
DPX-965 50DF	2	23	28	27	21	17	23.2		
LSD .05							6.1		
LSD .01							8.0		

^a/ Mean number of plants from 50 seeds per plot. Means followed by asterisks were significantly different from the mean for untreated seeds at the 1% (**) or 5% (*) level.

Table 8. Stand establishment by Lemont seeds treated with experimental fungicides and water-seeded, continuous flood at the Rice Research Station, Crowley, LA. (Planted on April 19, stand counts on May 23, 1985.)

Treatment	Rate (oz or fl oz/cwt) formulated)	Rep (stand counts)					Mean a/ Stand	% Change from control	% Stand
		I	II	III	IV	V			
Kocide Maneb	8	26	40	49	49	42	40.6**	72.0	81.2
Kocide SD + Kocide Maneb	4 + 4	27	42	47	42	42	40.0**	69.5	80.0
Kocide SD + Kocide Maneb + Kocide Zinc	3 + 3 + 5	24	37	54	34	48	39.4**	67.0	78.8
Kocide Maneb + Kocide Zinc	6 + 5	40	41	37	36	34	37.4**	58.5	74.8
Kocide Maneb	6	26	38	32	35	46	35.4**	50.0	70.8
Kocide Zinc	10	31	31	39	38	33	34.4**	45.8	68.8
Dithane M-45	6	27	32	39	39	34	34.2**	44.9	68.4
Kocide Maneb + Kocide Zinc	8 + 5	27	35	32	38	38	34.0**	44.1	68.0
Kocide SD	5	34	38	37	30	31	34.0**	44.1	68.0
Kocide SD + Kocide Maneb	3 + 3	17	37	39	41	31	33.0**	39.8	66.0
Dithane FZ	6	24	30	36	33	39	32.4**	37.3	64.8
Kocide SD + Kocide Zinc	5 + 5	21	35	32	36	37	32.2**	36.4	64.4
NC 28410 + Apron 25 WP	10 + 2	19	35	29	40	35	31.6**	33.9	63.2
Kocide SD	10	29	24	38	30	36	31.4**	33.1	62.8
NC 28410 + Apron 25 WP	10 + 0.75	30	23	35	30	37	31.0**	31.4	62.0
SN 84364 + Apron	4.5 + 2	26	20	27	41	41	31.0**	31.4	62.0
Apron F1	0.75	22	26	33	30	40	30.2**	28.0	60.4
Kocide SD + Kocide Zinc	10 + 5	22	32	27	34	34	29.8**	26.3	59.6
GUS 4002 -2 F1	1.5	33	28	29	29	28	29.4**	24.6	58.8
Dithane FZ	4	20	32	30	31	32	29.0**	22.9	58.0
SN 84364	3	24	23	32	29	36	28.8**	22.0	57.6
DPX-965 50 DF + Apron 25W	4 + 2	24	26	31	32	29	28.4**	20.3	56.0
NC 28410	6	24	30	30	28	29	28.2**	19.5	56.4
SN 84364 + Apron	4.5 + 0.75	22	27	32	35	23	27.8**	17.8	55.6
SN 84364 + Apron	6 + 0.75	23	23	33	33	27	27.8**	17.8	55.6
GUS 4044 25W	10	28	29	26	31	25	27.8**	17.8	55.6
A 1055 15WP	6	23	29	25	30	30	27.4**	16.1	54.8
Apron 25W + Imazalil/TCNTB	2 + 2	19	32	28	34	24	27.4**	16.1	54.8
Captan 400 D	3	18	30	23	35	30	27.2**	15.3	54.4
Vitavax 200 FF	4	19	33	32	30	21	27.0**	14.4	54.0
Dithane M-45	4	22	33	27	28	25	27.0**	14.4	54.0

CONTINUED.

Table 8. CONTINUED.

Treatment	Rate (oz or fl oz/cwt) formulated)	Rep (stand counts)					Mean ^{a/}	% Change from control	% Stand
		I	II	III	IV	V			
SN 84364	6	23	29	28	30	24	26.8**	13.6	53.6
A 1055 15WP + Apron 25W	6 + 2	24	26	31	26	27	26.8**	13.6	53.6
NC28410	8	26	25	23	29	31	26.8**	13.6	53.6
Terrazole 4 F1	4	22	21	26	31	34	26.8**	13.6	53.6
Captan 400 D	2	17	30	33	32	21	26.6**	12.7	53.2
DPX-965 50 DF	6	26	22	29	26	30	26.6**	12.7	53.2
Kocide Zinc	5	9	26	28	37	33	26.6**	12.7	53.2
DPX-965 50 DF + Apron 25W	6 + 2	27	24	31	23	28	26.6**	12.7	53.2
Imazalil/TCMTB	2	18	26	28	29	31	26.4**	11.9	52.8
A 1055 15WP	4	28	25	25	25	29	26.4**	11.9	52.8
Terrazole 4 F1	3	17	31	31	23	29	26.2**	11.0	52.4
SN 84364	4.5	22	29	28	31	20	26.0*	10.2	52.0
GUS 4044 25W	4	15	29	28	29	28	25.8*	9.3	51.6
SN 84364	12	18	26	28	29	26	25.4	7.6	50.8
NC 28410	10	15	26	29	29	27	25.2	6.8	50.4
A 1055 15WP + Apron 25W	4 + 2	23	23	29	29	17	24.2	2.5	48.4
SN 84364	8	19	18	26	23	35	24.2	2.5	48.4
GUS 4551 F1	1	19	24	27	21	30	24.2	2.5	48.4
Apron 25W	2	19	22	23	26	29	23.8	0.9	47.6
A 1055 15WP	10	16	27	23	28	25	23.8	0.9	47.6
GUS 4551 F1	2	15	23	20	29	32	23.8	0.9	47.6
DPX-965 50DF	2	22	25	21	26	25	23.8	0.9	47.6
Untreated	---	23	20	24	23	28	23.6	0.0	47.2
DPX-965 50DF	4	17	21	26	25	27	23.2	-1.7	46.4
Imazalil/TCMTB	4	18	19	23	23	31	22.8	-3.4	45.6
Prochloraz 40 SC	6	9	29	20	26	30	22.8	-3.4	45.6
Prochloraz 40 SC + Apron	6 + 0.75	8	29	29	27	19	22.4	-5.1	44.8
A 1055 15WP	2	19	28	24	15	19	21.0(-)**	-11.0	42.0
Prochloraz 40 SC	4	14	27	18	18	24	20.2(-)**	-14.4	40.4
LSD .05							2.0		
LSD .01							2.6		

^{a/} Mean number of plants from 50 seeds per plot. Means followed by asterisks were significantly different from the mean for untreated seeds at the 1% (**) or 5% (*) level.

CHEMICAL CONTROL OF BLAST IN LOUISIANA

(A Progress Report)

G.D. Lindberg and M.C. Rush

INTRODUCTION

Chemicals were tested for control of rice blast again in 1985. Several of the materials used in the blast test were selected from those obtained for use in the sheath blight test. These selections were made on the premise that materials that control both blast and sheath blight would be of greater application in the production of rice.

MATERIALS AND METHODS

Blast susceptible Early Colusa #2 was planted April 30, 1985. The plots were 4 x 40 ft. The fertilizer was applied at the rate per acre of 100-50-50. The chemicals were applied with a 2-nozzle boom at the rate of 20 gal/A, 40 psi. A single treatment was used, an application at booting and one at heading.

RESULTS AND DISCUSSION

Rice in plots treated with several of the materials, Benlate, Mertect, CGA 449, Prochloraz, DPX 965, NWG 160, and Al055, had significantly (1% level) fewer rotten-neck panicles than the untreated control. None of these materials were as effective in the control of sheath blight as were SN 84364 and NTN 197 but Benlate, DPX 96, and CGA 449 in combination with certain other materials have given good control of sheath blight.

Rough rice yields significantly (1% level) higher than the untreated controls were recorded from plots treated with DPX 965, Benlate, CGA 449, and Al055; the high yields were in close agreement with the low disease ratings for the same plots. Plots treated with Rovral and RH 4056 yielded well but had high disease ratings (Table 1).

Table 1. Rough rice yields and rotten-neck data from Early Colusa #2 sprayed with chemicals for blast control. Rice Research Station, Crowley, LA. 1985.

Treatment ^{1/}	Rate lb or pt/A (formulated)	Mean rotten-neck	Mean (lb/A)
Untreated		37.4	2703.0
NTN 197	0.5 lb	33.8	2719.4
RH 4056	2.0 lb	33.0	3390.8**
Rovral	2.0 lb	32.6	3462.6**
SN 8436	0.7 lb	32.6	2959.8
NC 2841	2.5 pt	31.6	3143.8
CGA 449	0.5 lb	30.4**	3060.6
Mertect	0.75 pt	28.2**	3165.6
Benlate	1.0 lb	27.6**	3467.6**
Prochloraz	1.25 pt	27.6**	2950.4
DPX 965	2.0 lb	27.6**	3293.0
CGA 449	1.0 lb	26.8**	3570.4**
HWG 1608	1.5 pt	25.4**	3090.0
Al055	2.0 pt	24.6**	3432.4**
DPX 965	1.0 lb	24.4**	3595.0**
Benlate	2.0 lb	22.8**	3584.0**

^{1/} An application at booting and at heading.

** Significant at the 1% level.

SOYBEAN RESEARCH

COMMERCIAL SOYBEAN VARIETY TEST

(A Progress Report)

J.L. Griffin, R.J. Habetz, and R.P. Regan

INTRODUCTION

Soybeans 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. Soybean 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. Testing programs are conducted at the Rice Research Station each year to compare performance of newly released and established varieties.

MATERIALS AND METHODS

Eighty-six soybean varieties (4 in Group IV, 27 in Group V, 28 in Group VI, 23 in Group VII, and 4 in Group VIII) were grown on a Crowley silt loam soil to compare yield and agronomic characteristics. Varieties were planted on May 14 and with the exception of the Group IV varieties were replanted on May 28. Seeding rate was approximately 60 lb/A (10 seed per row foot). Plots were four, 32-in rows 30 ft in length. A randomized complete block design with four replications was used. Fertilizer at a rate of 0-80-80 lb/A ($N-P_2O_5-K_2O$) was banded 2 inches on each side of the row at planting. Metolachlor (Dual)² at 2.0 lb/A was surface applied after planting. Plots were cultivated twice. Varieties were combine-harvested after maturity. Seed yield was calculated from yield per plot and adjusted to 13% moisture. Agronomic characteristics including plant height, lower pod height, and lodging were also measured.

RESULTS AND DISCUSSION

Group IV varieties were tested for the first time. These varieties can be planted in April as compared to mid-May without worry of yield reductions due to premature flowering which has been noted in some Group V varieties. The true yield potential of the Group IV varieties was probably not realized since they were planted on May 14. Even for the late planting date, 44.1 and 38.2 bu/A yields were obtained for RA 451 and RA 480, respectively (Table 1). Attempts will be made in future years to plant Group IV varieties in April to better evaluate potential productivity.

Only the Group IV and V varieties were harvested prior to Hurricane Juan. For the Group V varieties, yields exceeded 40 bu/A for FFR 561, Pioneer 9561, and Deltapine 105 (Table 1). Yields were similar to those of other recommended

Table 1. Performance of commercial soybean varieties grown on a Crowley silt loam soil at the Rice Research Station, Crowley, LA. 1985.

Maturity group and variety	Yield ^{1/} (bu/A)	3-yr. (1983-85) average yield (bu/A)	Plant height at maturity (in)	Date matured	Lodging ^{2/} pod above ground	Height of lower pod above ground (in)
Group IV						
RA 451	44.1 a	--	34	Sept. 24	1	4
RA 480	38.2 ab	--	36	Sept. 12	1	4
RA 452	34.3 bc	--	33	Sept. 11	1	3
Stevens	29.3 c	--	31	Sept. 7	1	3
Group V						
FFR 561	40.7 a	--	26	Sept. 23	1	5
Pioneer 9561	40.6 ab	--	32	Sept. 25	1	5
Deltapine 105	40.5 ab	45.4	33	Oct. 2	1	5
Wilstar 550	39.0 abc	44.1	32	Oct. 7	1	4
Yield King 593	38.1 abcd	42.0	31	Oct. 9	1	4
A 5474	37.9 abcd	40.1	26	Sept. 25	1	4
Gurley 569	37.7 abcd	--	31	Oct. 9	2	4
Yield King 503	37.4 abcd	41.0	37	Sept. 25	1	5
Terra-Vig 553	37.1 abcd	--	32	Oct. 2	1	5
Hartz 5370	37.1 abcde	--	34	Oct. 7	2	5
Terra-Vig 505	37.0 abcde	42.6	33	Oct. 2	3	5
Pioneer 9571	36.8 abcde	--	31	Oct. 9	2	4
Buckshot 500	36.7 abcdef	--	26	Oct. 7	1	4
Coker 425	36.6 abcdef	--	18	Sept. 19	1	3
Pioneer 5482	36.5 bcdef	--	32	Oct. 7	1	6
Forrest	35.4 cdefg	39.4	33	Oct. 7	2	5
Deltapine 345	35.2 cdefg	39.8	34	Oct. 9	2	4
Hartz 5252	35.2 cdefg	--	31	Sept. 25	2	5
Coker 485	35.0 cdefg	--	31	Oct. 7	2	5
Coker 575	34.8 cdefg	--	30	Oct. 2	1	4
Coker 355	34.7 defg	--	27	Oct. 7	1	4
Shiloh	34.4 defg	--	32	Oct. 7	1	5

CONTINUED.

Table 1. (Continued).

Maturity group and variety	Yield ^{1/} (bu/A)	3-yr. (1983-85) average yield (bu/A)	Plant height at maturity (in)	Date matured	Lodging ^{2/} pod above ground	Height of lower pod above ground (in)
<u>Group V (Continued)</u>						
Terra-Vig 515	34.2 defg	--	29	Oct. 2	2	5
Yield King 563	34.1 defg	39.6	34	Oct. 7	2	5
A 5980	32.9 efg	--	32	Oct. 9	2	5
FFR 560	32.5 fg	--	33	Oct. 9	2	5
Hartz 5171	32.1 g	--	41	Oct. 7	3	6
<u>Group VI</u>						
A 6381	39.6 a	--	29	Oct. 11	1	5
Hartz 6130	35.3 ab	--	37	Oct. 11	1	4
Sharp	33.0 b	--	33	Oct. 7	1	5
Buckshot 600	27.6 c	--	38	Oct. 11	2	6
Coker 686	23.8 cd	--	32	Oct. 20	1	5
Centennial	23.1 cde	37.5	34	Oct. 20	1	5
RA 680	22.4 def	36.5	39	Oct. 27	2	5
FFR 668	22.1 def	--	33	Oct. 22	2	4
A 6520	21.5 defg	35.1	29	Oct. 29	1	3
Deltapine 566	21.0 defgh	--	33	Oct. 27	2	4
S 69-54	20.9 defgh	--	34	Oct. 27	3	5
Coker 596	20.6 defgh	--	33	Oct. 17	2	4
Deltapine 506	20.5 defghi	34.8	38	Oct. 29	2	5
A 6242	20.2 defghi	--	32	Oct. 20	1	4
Sampson	20.1 defghi	--	31	Oct. 29	2	5
Terra-Vig 616	20.0 defghi	--	33	Oct. 28	1	4
Davis	19.3 defghij	34.5	36	Oct. 25	2	4
RA 606	18.7 defghij	34.5	39	Oct. 27	3	5
RA 604	18.4 defghij	34.6	34	Oct. 23	1	5
Gurley 651	17.4 efghij	--	36	Oct. 18	4	5
Tracy-M	17.2 efghij	36.5	32	Oct. 29	3	5

CONTINUED.

Table 1. (Continued).

Maturity group and variety	Yield ^{1/} (bu/A)	3-yr. (1983-85) average yield (bu/A)	Plant height at maturity (in)	Date matured	Lodging ^{2/} (in)	Height of lower pod above ground (in)
Group VI (Continued)						
Spartan	17.2 efghij	--	42	Oct. 28	3	5
S 69-96	17.1 fghij	--	33	Oct. 22	3	4
Yield King 613	16.5 fghij	35.1	40	Oct. 25	2	5
Gurley 652	15.9 ghij	--	36	Oct. 19	3	5
Hartz 6383	15.4 hij	28.9	37	Oct. 28	2	5
Sanalona	14.7 ij	--	34	Oct. 25	5	4
Bradley	13.7 j	25.7	Oct. 28	2	4	
Group VII						
Pioneer 9791	19.4 a	--	31	Oct. 27	2	4
Terra-Vig 717	17.7 ab	--	32	Oct. 29	3	4
Deltapine 497	17.5 ab	--	34	Nov. 8	1	5
Terra-Vig 708	17.3 ab	34.3	34	Nov. 3	2	4
Coker 237	16.3 ab	36.3	30	Oct. 26	1	4
Starr	16.1 ab	--	30	Oct. 29	2	4
Ransom	15.4 ab	35.6	33	Oct. 30	2	4
ESX 13600	15.3 ab	--	36	Nov. 8	2	5
ESX 5217	15.3 ab	--	36	Nov. 8	2	5
Deltapine 417	15.2 ab	--	38	Nov. 2	2	5
Young	15.1 ab	--	35	Oct. 27	3	5
NK S 72-60	14.8 ab	32.1	37	Oct. 30	4	4
Wright	14.5 abc	35.7	37	Nov. 7	4	5
Hartz 79-21046	14.1 abc	--	31	Oct. 29	2	4
Leflore	14.0 abc	--	32	Oct. 30	1	4
FFR 771	13.7 bc	--	35	Oct. 30	2	5
Johnston	13.6 bc	--	33	Oct. 30	3	5
Coker 627	13.5 bc	--	34	Oct. 27	2	4
RA 702	13.0 bc	--	32	Oct. 26	2	4

CONTINUED.

Table 1. (Continued).

Maturity group and variety	Yield ^{1/} (bu/A)	3-yr. (1983-85) average yield (bu/A)	Plant height at maturity (in)	Date matured	Lodging ^{2/}	Height of lower pod above ground (in)
<u>Group VII (Continued)</u>						
McNair 770	12.7 bc	--	31	Oct. 27	2	4
Hartz 7126	12.7 bc	35.3	37	Oct. 28	3	5
LA 78-11682	12.3 bc	--	30	Oct. 30	2	4
Gordon	9.2 c	--	35	Oct. 27	3	5
<u>Group VIII</u>						
Coker 368	16.2 a	35.0	35	Oct. 20	2	5
Hartz 8112	14.9 ab	--	37	Nov. 8	1	5
Terra-Vig 808	14.2 b	29.0	35	Oct. 28	3	4
RA 801	13.5 b	--	38	Nov. 1	2	5

^{1/} Yields in each maturity group followed by a letter in common do not differ significantly at the 5% level of probability according to Duncan's multiple range test.

^{2/} 1 = no lodging; 5 = all plants lodged.

varieties, Wilstar 550, A 5474, and Terra-Vig 505, but were higher than those of Forrest and Deltapine 345. Both seed yield and quality of Groups VI, VII, and VIII varieties were severely affected by weather conditions in 1985. For the Group VI varieties, yields were 33 bu/A or more for A 6381, Hartz 6130, and Sharp; A 6381 yielded 39.6 bu/A and yields for the remaining Group VI varieties ranged from 27.6 bu/A for Buckshot 600 to 13.7 bu/A for Bradley. Yields of the recommended varieties, Centennial, RA 680, and Deltapine 506, were similar and averaged 22.0 bu/A. All Group VII varieties yielded less than 20 bu/A. Terra-Vig 708, Coker 237, Ransom, and Wright yields were similar and averaged 15.9 bu/A. Yields of the Group VIII varieties Coker 368, Hartz 8112, Terra-Vig 808, and RA 801 averaged 14.7 bu/A.

Soybean yields, with the exception of the Group V varieties, were lower than those observed for the three previous years. Reduced seed yield and quality were directly related to excessive rainfall associated with Hurricane Juan. Plant heights ranged from 42 inches for Spartan (Table 1) to 26 inches for FFR 561, A 5474, and Buckshot 500. Lodging was most severe (rating of 4-5) for Gurley 651, Sanalona, NK S 72-60, and Wright. Lower pod heights were at least 4 inches for all varieties except RA 452, Stevens, Coker 425, and A 6520.

Three-year average yields for the Group V varieties exceeded 40 bu/A for Deltapine 105, Wilstar 550, Terra-Vig 505, Yield King 593, Yield King 503, and A 5474 (Table 1). Deltapine 105 averaged 45.4 and 47.3 bu/A over 3 and 4 years, respectively. Group VI varieties Centennial, Tracy-M, and RA 680 averaged more than 36.0 bu/A over the 3-year period. Three-year average yields for the Group VII varieties were highest for Coker 237 (36.3 bu/A) and exceeded 35.0 bu/A for Wright, Ransom, and Hartz 7126. For the Group VIII varieties, 3-year average yields were 35.0 bu/A for Coker 368 and 29.0 bu/A for Terra-Vig 808. The lower 3-year average yields for the Groups VI, VII, and VIII varieties as compared to the Group V varieties were due to depressed yields in 1985.

INFLUENCE OF CROPPING SYSTEMS ON LONG-TERM SOYBEAN PRODUCTION ^{1/}

(A Progress Report)

J.L. Griffin, R.J. Habetz, and R.P. Regan

INTRODUCTION

Soybean producers have reported yield reductions associated with soybeans grown continuously. Explanation for the yield declines are speculative. Interest in the potential of alternate cropping systems for alleviating the problem has been expressed. In addition, increased concern over soil erosion and interest in no-till seeding of soybeans in wheat stubble and cover crop residue have prompted initiation of research on alternate cropping systems involving soybeans. In recent years, interest in double cropping wheat and soybeans, in using grain sorghum as an alternate crop for soybeans, and in using cover crops such as vetch for soil conservation and rebuilding purposes has increased. Studies supported by the Louisiana Soybean and Grain Research and Promotion Board are being conducted to determine the influence of alternate cropping systems on long-term soybean yields and to determine factors affecting yield decline in continuous soybeans.

MATERIALS AND METHODS

An area on the Rice Research Station which had been in soybean production 5 years prior to initiation of the study was used. The five cropping systems evaluated were: 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 sequence for each year of the study is shown in Table 1.

In 1982, 'Centennial' soybeans (75 lb/A) and 'G 1701' grain sorghum (6 lb/A) were planted on May 11. Fertilizer at a rate of 0-80-80 lb/A (N-P₂O₅-K₂O) for soybeans and 23-92-92 lb/A for grain sorghum was banded at planting. Sorghum was topdressed with 100-0-0 lb/A on June 15. After planting, a tank mix of metolachlor (Dual) at 2 lb ai/A + metribuzin (Sencor/Lexone) at 0.38 lb ai/A was applied on soybean plots and Dual at 2 lb ai/A + atrazine at 1.50 lb ai/A was applied on grain sorghum plots. Soybeans were harvested on October 19 and grain sorghum on August 31. Following harvest, the experimental area was worked and 'Southern Belle' wheat (90 lb/A) and 'Nova II' vetch (35 lb/A) were seeded on November 9. Both wheat and vetch received 23-92-92 lb/A at planting and wheat was topdressed with 75-0-0 lb/A at internode elongation. Following harvest of wheat on May 25, 1983, the experimental area was double-disked and Centennial soybeans were planted on June 1. Soybeans were harvested on October 28 following which 'Coker 762'

^{1/} This research supported in part by funds provided by soybean producers through the Louisiana Soybean and Grain Research and Promotion Board.

Table 1. Cropping systems to be evaluated at the Rice Research Station, Crowley, LA. 1982-1987.

Treatment no.	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.

wheat and 'Cahaba White' vetch (58 lb/A) were planted November 2. After harvest of wheat on May 10, 1984, Centennial soybeans were planted on May 11 and harvested on November 7. Coker 762 wheat and a 'Vantage'/hairy vetch mixture were planted on December 17, 1984. 'R 1090' grain sorghum was planted on April 18, 1985, and following harvest of wheat on May 10, Centennial soybeans were planted on May 29. Grain sorghum was harvested on August 6 and soybeans were harvested on November 7. Seeding rates, fertilization, and weed control practices each year were the same as those described for 1981.

In both 1982 and 1985, the fallow treatment consisted of frequent plowing during the summer months. Soil samples were taken yearly from each plot in June and analyzed at the LSU soil testing laboratory. A randomized complete block experimental design with three replications was used. Plots were approximately 0.2 acre in size. All crops were combine harvested and yields were adjusted to 13% moisture for soybeans and wheat and 15% moisture for grain sorghum.

RESULTS AND DISCUSSION

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 rotations, averaging 1.8%. Soybean yields over 4 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 and 1985 (Table 2). The lower yields in 1984 and 1985 were due in part to inclement weather around harvest time. Soybean yields over the 4 years averaged 2.5 bu/A lower where soybeans followed wheat as compared to 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.

Table 2. Crop yields for the soybean cropping systems study. Rice Research Station, Crowley, LA. 1982-1985.

Cropping system	Yield (bu/A)						
	Fall 1982	Spring 1983	Fall 1983	Spring 1984	Fall 1984	Spring 1985	Fall 1985
Continuous soybeans	42.2	--	42.1	--	20.6	--	19.4
Soybeans/wheat	39.4	35.0	40.0	63.0	20.8	53.7	14.3
Soybeans/vetch	43.1	--	43.1	--	20.1	--	17.7
Grain sorghum - soybeans	3648 lb/A	--	45.1	--	19.6	--	5818 lb/A
Fallow plow - soybeans	--	--	46.3	--	20.4	--	--
LSD (0.05)	NS	--	3.1	--	NS	--	NS

Disease and insect pressure have been similar regardless of the cropping system. Weed pressure, especially from mexicanweed [*Caperonia castaniifolia* (L.) St. Hil.], and drought stress were more severe in soybeans following wheat as compared to the other cropping systems. In future years, designated cropping systems shown in Table 1 will be imposed. The influence of the various cropping systems on soil pH, fertility, organic matter, insect, weed, and disease pressure, and crop yields will be measured.

AN INTEGRATED APPROACH TO RED RICE CONTROL ^{1/}

(A Progress Report)

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INTRODUCTION

Red rice in Louisiana reduces both yield and quality of domestic rice. Control programs for red rice include the combination of prevention, rotation, cultural, and chemical practices. Research has shown that a high degree of red rice control (>90%) can be obtained in soybeans and in rice. However, information on the effectiveness of combining various control methods to reduce red rice severity in a soybean-rice rotation system in Louisiana is limited. Studies supported by the Louisiana Rice Research Board are being conducted to determine the effectiveness of combining cultural and chemical practices for red rice control in soybean-rice rotation systems.

MATERIALS AND METHODS

Twenty acres at the Rice Research Station South Farm are being used to conduct these studies with 5 acres designated for each individual treatment. The treatments consist of a 2-year/1-year and 1-year/1-year soybean-rice rotation using a high level of red rice control in both crops and a 2-year/1-year and 1-year/1-year soybean-rice rotation using more traditional methods of red rice control. The rotation systems and cropping sequence are shown in Table 1.

In the first year of the study in 1982, 'Davis' soybeans were drill seeded at 75 lb/A on June 25. Red rice was seeded prior to land preparation to assure a severe red rice infestation when the rotations were implemented in 1983. A tank mix of metolachlor (Dual) at 0.75 lb ai/A plus metribuzin (Sencor/Lexone) at 0.25 lb ai/A was surface applied after planting to suppress weed species other than red rice.

In 1983, 20 acres were planted to 'Centennial' soybeans on May 1. Two levels of red rice control (10 acres each) were imposed. A high level of control consisted of a shallow-incorporated preemergence application of metolachlor at 2.5 lb ai/A and metribuzin at 0.38 lb ai/A followed by a postemergence overtop application of bentazon (Basagran) at 0.75 lb ai/A plus mefluidide (Embark) at 0.13 lb ai/A on June 21 when red rice was 2 to 3 inches in height. A low level of control consisted of only a surface applied preemergence treatment at the herbicide rates previously described. Soil samples (15/1.7 acres) were taken prior to planting and washed to obtain red rice soil population estimates. Red rice plant population at soybean maturity was visually estimated. Yields were adjusted to 13% moisture.

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

Table 1. Rotation systems and levels of red rice control to be evaluated at the Rice Research Station, Crowley, LA. 1983-1988.

Field no.	Rotation system	Red rice control level ^{1/}	Cropping sequence - year					
			1983	1984	1985	1986	1987	1988
1	2:1	high	SB	SB	R	SB	SB	R
2	2:1	low	SB	SB	R	SB	SB	R
3	1:1	high	SB	R	SB	R	SB	R
4	1:1	low	SB	R	SB	R	SB	R

^{1/} High level of control in soybeans includes PPI Dual (2.5 lb ai/A) + Sencor/Lexone (0.38 lb ai/A) and POT Embark (0.13 lb ai/A) + Basagran (0.75 lb ai/A); low level of control includes PE Dual (2.5 lb ai/A) + Sencor/Lexone (0.38 lb ai/A). High level of control in rice includes water seeding, Ordram (4 lb ai/A), pinpoint flood water management; low level of control includes water seedings and prolonged drainage water management.

In 1984, 10 acres (1:1 rotation) were water seeded to 'Leah' rice (135 lb/A) on April 13. The high level of red rice management (5 acres) was to consist of molinate (Ordram) applied in the water at 4 lb ai/A just prior to planting and pinpoint flood water management. The low level of red rice management (5 acres) was to include prolonged drainage water management without Ordram. Due to unusually cool temperature rice growth was slower than normal and pinpoint flooding could not be used. Consequently, both areas, with the exception of Ordram, were managed similarly and were flushed on April 17, 20, and 24. Propanil was applied at 4 lb ai/A on May 1 and the permanent flood was imposed on May 2. On both management areas, fertilizer at the rate of 60-60-60 lb/A (N-P₂O₅-K₂O) was applied prior to planting on April 5 and incorporated. Nitrogen was applied at the rate of 60-0-0 lb/A on May 1 and at 45-0-0 lb/A in the water on June 7. Soil samples were taken on April 9 and 10 to determine red rice seed population prior to planting and red rice panicle counts were taken at maturity. Rice yields were determined by randomly combine-harvesting 6 areas 675 ft² in size from each 5-acre treatment. Yields were adjusted to 12% moisture. Grade was determined at the mill.

Ten acres (2:1 rotation) were drill planted to Centennial soybeans at 75 lb/A on May 15, 1984. Fertilizer at the rate of 0-80-80 lb/A was applied and incorporated on May 1. The high level of red rice management (5 acres) consisted of shallow-incorporated metolachlor plus metribuzin just prior to planting followed by a postemergence overtop application of bentazon plus mefluidide for red rice control at rates previously described. The low level of control (5 acres) consisted of only a surface-applied preemergence treatment. Soil samples were taken from both areas on May 15 to determine red rice seed population. Soybean yields were determined by randomly combine-harvesting 6 areas 675 ft² in size from each 5-acre treatment. Yields were adjusted to 13% moisture.

In 1985, Leah rice (135 lb/A) was planted on April 12 on 10 acres following 2 years of soybeans. Fertilizer at the rate of 60-60-60 lb/A was applied prior to planting on April 5 and incorporated. The high level of red

rice control consisted of molinate at 4 lb ai/A applied preplant incorporated, water seeding, and pinpoint flood water management. Under the pinpoint water management, the field was drained on April 15 and the permanent flood was established on April 18. Nitrogen was applied at the rate of 30-0-0 lb/A just ahead of the permanent flood. For the low level of control, Ordram was not applied but rice was water seeded and the permanent flood was delayed until May 6 when rice reached the 4- to 5-leaf stage. Nitrogen was applied at the rate of 30 lb/A just ahead of the permanent flood. Both management areas were treated with propanil at 4 lb ai/A on May 6. In addition, Furadan at 20 lb/A and nitrogen at the rate of 30 lb/A were applied in the water on June 6. Soil samples were taken just prior to planting to determine red rice seed population. Rice was harvested on August 13 and yields were determined as described for 1984.

Centennial soybeans were planted on May 30, 1985, following 1 year of rice. Fertilizer at the rate of 0-80-80 lb/A was applied prior to planting. The high level of red rice control consisted of metolachlor plus metribuzin preplant incorporated followed by a postemergence over-the-top application of bentazon plus mefluidide. The low level of control consisted of only a surface-applied preemergence treatment. Soil samples were taken from both areas just after planting to determine red rice seed population. Soybean yields were determined as described for 1984.

RESULTS AND DISCUSSION

In the 1:1 rotation system, rice yields in 1984 were similar for both high and low red rice control levels ($\bar{x}$ =6056 lb/A) (Table 2). Rice grade, however, was 1 to 2 for the high level of control and 5 to 6 for the low level of control. Red rice panicle counts made just prior to rice harvest were lowest under the high level of control. The reduced grade under the low management level was due primarily to the presence of red rice. In the 1:1 rotation, only one year of intensive red rice management was allowed before rice was planted in 1984. Red rice seed/core were much higher initially in 1983 for low technology compared to the high technology (13.2 vs. 2.8 seed/core). However, under the 1 year of intensive management, levels were decreased markedly under both management levels. Red rice panicle counts made in 1984 were much greater under the low as compared to the high red rice control level (8.9 vs. 1.6 panicles/ft²). The higher red rice seed production was directly related to the level of red rice management in the rice crop.

In the 2:1 rotation system, soybean yields in 1984 managed using the high and low level of red rice control following a previous year of the same management were similar averaging 20.9 bu/A (Table 2). Red rice seed/core decreased substantially from 1983 to 1984 and the decrease was similar for both high and low red rice control levels. In addition, red rice seed production in the soybeans during 1984 was minimal.

In 1985, red rice present in domestic rice following 2 years of soybeans was minimal regardless of the management system used. Red rice panicles, however, were more prevalent in the low level of control as compared to the high level. Rice yields under the two management levels were approximately 6100 lb/A (12% moisture) and rice grade was 1 to 2. In the 1:1 rotation, red rice infestation in the 1984 rice crop, especially under the low management level, was quite severe. Red rice in soybeans in 1985, however, was minimal under both management levels, indicating the importance of red rice control in

Table 2. Influence of rotation systems and levels of red rice control on crop yields, grade, and red rice infestation. Rice Research Station, Crowley, LA. 1983-1984.

Rotation ^{1/} - Parameters	Red rice control level	
	High technology	Low technology
<u>1:1 Rotation</u>		
<u>1983</u>		
Red rice seed/core ^{2/}	2.76	13.18
Red rice panicles/ft ^{23/}	0	0
Soybean yield (bu/A)	37.0	37.0
<u>1984</u>		
Red rice seed/core ^{2/}	0.32	1.13
Red rice panicles/ft ^{23/}	1.60	8.90
Rice yield (lb/A)	5916	6195
Rice grade	1-2	5-6
<u>1985</u>		
Red rice seed/core ^{2/}	0	0
Red rice panicles/ft ^{23/}	0	0
Soybean yield (bu/A)	15.0	15.0
<u>2:1 Rotation</u>		
<u>1983</u>		
Red rice seed/core ^{2/}	3.70	3.84
Red rice panicles/ft ^{23/}	0	0
Soybean yield (bu/A)	37.0	37.0
<u>1984</u>		
Red rice seed/core ^{2/}	0.93	0.76
Red rice panicles/ft ^{23/}	0	0
Soybean yield (bu/A)	21.7	20.2
<u>1985</u>		
Red rice seed/core ^{2/}	0	0
Red rice panicles/ft ^{23/}	0	0
Rice yield (lb/A)	6183	6037
Rice grade	1	1-2

^{1/} 1:1 = 1 year soybean/1 year rice; 2:1 = 2 year soybean/1 year rice.

^{2/} Determined just prior to planting either rice or soybeans.

^{3/} Determined at crop maturity.

soybeans in the rotation system. Soybean yields under high and low levels of red rice control were similar, averaging 15 bu/A. Exceptionally low soybean yields were due to excessive rainfall around harvest time.

Results point to the importance of 2 years of intensive red rice management in soybeans on reducing potential red rice infestation levels in the subsequent rice crop. In addition, findings indicate the importance of combining cultural and chemical practices for red rice control in both soybeans and rice.

Due to the minimal amount of red rice present in the experimental area in 1985, a new red rice infested area will be used in future years to further evaluate long-term effects of the rotation systems and levels of red rice control on crop production.

EVALUATION OF BURNDOWN HERBICIDES IN NO-TILL SYSTEMS WITH LEGUME COVER CROPS

(A Progress Report)

J.L. Griffin, R.J. Habetz, and R.P. Regan

INTRODUCTION

Use of legumes from the standpoint of N-fixation, erosion control, and production potential for direct seeding of soybeans [Glycine max (L.) Merr.] or grain sorghum [Sorghum bicolor (L.) Moench] offers a viable option for the south Louisiana area. Ideally, legumes with natural reseeding capability would be most desirable. Where the subsequent crop requires seeding prior to maturity of the legume, herbicides will be needed to kill the cover crop in order to facilitate planting. Information is presently available on Paraquat and Roundup for control of annual grasses and broadleaf weeds in stale seedbed or no-till systems but little information is available on efficacy of these herbicides and other similar materials on legume cover crops. Studies were conducted at the Rice Research Station to evaluate several herbicides at various rates for control of subterranean clover (Trifolium subterraneum L.), crimson clover (T. incarnatum L.), and vetch (Vicia villosa Roth) and to determine response of grain sorghum and soybeans planted no-till following legume cover crops.

MATERIALS AND METHODS

'Mt. Barker' subterranean clover at 23 lb/A, 'Tibbee' crimson clover at 28 lb/A, and hairy vetch at 58 lb/A were planted on December 18, 1984. Seed were inoculated with proper Rhizobium strains prior to planting. Fertilizer at a rate of 0-77-77 lb/A ($N-P_{25}O_5-K_2O$) was banded at planting. Herbicide treatments including Paraquat at 0.50 and 1.00 lb ai/A in 20 and 40 gal/A of spray volume, Roundup and SC 0224 at 1.50 and 2.50 lb ai/A in 6 gal/A of spray volume, and HOE 39866 at 0.75 and 1.50 lb ai/A in 6 gal/A of spray volume were applied on April 2 (early application) and May 7 (late application). Nonionic surfactant (X-77) was added at the rate of 1/2 pt/100 gallons of water to the Paraquat treatments. The 40 gal/A spray volume was delivered using 8006 nozzles at 30 psi pressure. The 20 gal/A spray volume was delivered using 8003 nozzles at 25 psi pressure. The 6 gal/A spray volume was delivered using 800067 nozzles at 30 psi pressure. Plot size was 5 x 30 ft and the entire plot was treated. At the time of early herbicide application sub clover, crimson clover, and vetch were at the vegetative growth stage and dry matter yield averaged 1190, 1790, and 830 lb/A, respectively. At the time of the late herbicide application, sub clover was at mid bloom and crimson clover and vetch were at seed development and yields averaged 1790, 3310, and 2180 lb/A, respectively. 'R 1090' grain sorghum was planted on April 18 following the early application. Fertilizer was banded at planting at a rate of 40-80-80 lb/A. 'Centennial' soybeans were planted on May 28 following the late application. Fertilizer was banded at planting at a rate of 0-60-60 lb/A. Both grain sorghum and soybeans were

planted using a John Deere no-till planter on 30-inch row spacing. After planting grain sorghum, the experimental area received a broadcast application of Dual at 2.0 lb ai/A plus atrazine at 1.2 lb ai/A. In addition, 0.13 lb ai/A paraquat was added to kill weeds which had emerged since initial herbicide application. After planting soybeans, Dual at 2.0 lb ai/A plus paraquat at 0.13 lb ai/A was applied to the entire area. Cover crop control ratings were made following the early herbicide application 16 days after treatment (DAT) on May 9. For the late herbicide application, cover crop control ratings were made on May 27 (20 DAT) and soybean stand ratings were made on June 13. Yields were determined for both grain sorghum and soybeans.

RESULTS AND DISCUSSION

Cover crop control ratings indicated that sub clover was most difficult and vetch least difficult to control (Table 1). Paraquat applied at 1.0 lb/A in either 20 or 40 gal/A provided at least 97% sub clover control for the late application but 80% control at the early application. Even though more sub clover biomass was present at the late application, the increased control was probably due to warmer temperatures which encouraged greater paraquat activity. Poor sub clover control was noted for both Roundup and SC 0224 at 1.50 and 2.50 lb/A. Hoe 39866 at 1.68 lb/A provided excellent sub clover control at both the early and late application dates. Crimson clover control ratings were not obtained for the late application since it had matured by the time herbicides were applied. At the early application, paraquat at 0.50 and 1.00 lb/A in either 20 or 40 gal/A and HOE 39866 at 0.75 and 1.50 provided at least 95% crimson clover control. Poor crimson clover control was noted for both Roundup and SC 0224. Vetch control was at least 85% for paraquat at 0.50 and 1.00 lb/A in both 20 and 40 gal/A and for HOE 39866 at 0.75 and 1.50 lb/A for both the early and late applications. Roundup and SC 0224 at 2.50 lb/A provided at least 93% vetch control at the late application but only approximately 50% control for the early application.

Grain sorghum stands were good to excellent when planted into sub, crimson, and vetch residue. Even though initial control of sub clover for some herbicide treatments was low, additional burndown activity was noted as a result of application of atrazine at planting. Consequently, little competition from the cover crops was noted after emergence of grain sorghum.

Soybean stands were good to excellent in crimson clover and vetch. Even though the planter adequately placed seed into the soil, a soybean stand was not obtained in sub clover residue. Further studies will be needed to address possible causes of stand failure.

Grain sorghum and soybean yields when planted in crimson clover and vetch residues were similar regardless of the herbicide treatment. Grain sorghum yields tended to be highest when planted into sub clover residue ($\bar{x}$ = 4840 lb/A) and lowest when planted into vetch residue ($\bar{x}$ = 3310 lb/A). Soybean yields were very low when planted into crimson clover ($\bar{x}$ = 14.6 bu/A) and vetch (12.1 bu/A) residue, primarily due to excessive rainfall which occurred around soybean maturity.

Reseeding was noted for only crimson clover.

Table 1. The effect of herbicide treatments on control of 'Mt. Barker' subterranean clover, 'Tibbee' crimson clover, and hairy vetch grown as cover crops. Rice Research Station, Crowley, LA. 1985.

Herbicide	Rate (lb ai/A)	Spray volume (gal/A)	Cover crop control ^{1/}					
			Early application			Late application		
			Sub clover	Crimson clover	Vetch	Sub clover	Crimson ^{2/} clover	Vetch
			-----%					
Paraquat	0.50	20	30	95	93	82	NR	100
	1.00	20	78	98	98	100	NR	100
	0.50	40	40	97	83	44	NR	100
	1.00	40	80	98	95	97	NR	100
Roundup	1.50	6	22	32	57	13	NR	78
	2.50	6	25	30	50	23	NR	93
SC 0224	1.50	6	17	25	53	17	NR	83
	2.50	6	25	33	62	23	NR	95
HOE 39866	0.75	6	100	100	100	79	NR	100
	1.50	6	100	100	100	90	NR	100
LSD (0.05)			15	10	17	15		6

^{1/} Herbicide treatments applied early on 4/2 and late on 5/7. Cover crop control ratings made 16 and 20 DAT for early and late applications, respectively.

^{2/} Crimson clover not rated (NR) since it had matured prior to herbicide application.

SOYBEAN TOLERANCE TO PRE- AND POSTEMERGENCE HERBICIDES

(A Progress Report)

J.L. Griffin, R.J. Habetz, and R.P. Regan

INTRODUCTION

Both efficacy and crop tolerance are important factors in determining potential herbicide use. Several herbicides presently available or which will be recommended in the near future can cause burning of plant foliage and/or stunting. Even though plants apparently "grow out" of the injury, farmers are concerned over the ultimate effect on crop yield. Under ideal growing conditions of good rainfall and little weed or disease pressure, soybean plants can readily compensate for reduced stands or crop injury. However, under adverse conditions typical of the southwest Louisiana area, the inability of plants to compensate for early season soybean injury may result in reduced yields. Studies were conducted to evaluate soybean tolerance to preemergence and pre-/postemergence sequential herbicide applications and to determine plant response symptomology. In addition, postemergence herbicides were applied at two soybean growth stages to evaluate injury and to characterize plant response to injury.

PRE- AND PRE-/POSTEMERGENCE SEQUENTIAL TEST

MATERIALS AND METHODS

'Centennial' soybeans were planted on 30-in row spacings on May 14 at the Rice Research Station. Fertilizer at the rate of 0-60-60 lb/A ($\text{N-P}_{25}\text{-K}_{20}$) was banded at planting. Preemergence (PE) herbicides, Sencor, Scepter, Canopy, Command, AC 263,499, Lorox, R 8259, and DPX F6025 were surface applied after planting. The entire experimental area was overtreated with Dual at 1.5 lb/A. One hour after herbicide application 1.8 inches of rain was received and 2 inches of rain was received 1 week after planting. Scepter and Classic were applied postemergence over-the-top (POT) on June 5 when soybeans were at the V3 (two fully expanded trifoliates) growth stage and 4 to 5 inches in height. All herbicide treatments were applied in 22 gal/A of spray volume at 26 psi pressure. Plots were cultivated twice and the experimental area was weed free. Stand counts were made on June 4 and phytotoxicity ratings were made for June 5, July 3, and July 22. Plant height and lower pod height were measured at soybean maturity. Plots were combine-harvested and yields were adjusted to 13% moisture. A randomized complete block design with four replications was used. Plot size was 10 x 30 ft (four 30-in rows) and the two inside rows were treated.

RESULTS AND DISCUSSION

Soybean stands and yields were not affected by the herbicide treatments (Table 1). Phytotoxicity was minimal for all treatments with the exception of Scepter PE at 0.25 and 0.38 lb/A which averaged approximately 25%. Injury from Scepter was manifested primarily as stunting of plants. Soybeans did not recover and mature plant heights where Scepter was applied at 0.25 and 0.38 lb/A were 3 to 5 inches lower than the other treatments. Crop yields were excellent for all herbicide treatments and the reduced plant height of soybeans treated with Scepter at the higher rates did not affect crop yield. It should be noted that for the proposed labelled rate of Scepter at 0.13 lb/A, soybean injury was not observed.

POSTEMERGENCE TEST

MATERIALS AND METHODS

Centennial soybeans were planted on 30-in row spacings on May 14 at the Rice Research Station. Due to poor stand following excessive rainfall after planting, soybeans were replanted on a stale seedbed on May 27. Fertilizer at the rate of 0-60-60 lb/A ($N-P_{25}O_5-K_2O$) was banded at the first planting. The entire experimental area was ²overtreated with Dual at 1.5 lb/A. Scepter, Classic, Cobra, Reflex, Basagran, Blazer, 2,4-DB, AC 263,499, and Dyanap were applied postemergence when soybeans were at the V2 (one fully expanded trifoliolate) growth stage on June 11 and again on separate plots at the V4 (three fully expanded trifoliolates) growth stage on June 24. All herbicide treatments were applied in 22 gal/A spray volume at 26 psi pressure. Plots were cultivated twice and the experimental area was weed free. Phytotoxicity ratings were made on July 3 and 22. Plant height and lower pod height were measured at soybean maturity. Plots were combine-harvested and yields were adjusted to 13% moisture. A split plot design replicated four times with soybean growth stages as whole plots and herbicide treatments as sub plots was used. Plot size was 7.5 x 30 ft (three 30-in rows) and the two inside rows were treated.

RESULTS AND DISCUSSION

Since there was no difference in soybean response to time of herbicide application, data are presented as a mean over V2 and V4 application times. For all parameters measured, no significant differences were observed (Table 2). There were significant differences, however, between times of application for the phytotoxicity ratings. On both rating dates (July 3 and 22), crop injury was more severe where herbicides were applied at V4 as compared to V2. Plants treated early were able to more rapidly overcome injury. Phytotoxicity was minimal and symptoms included leaf burn and crinkling, and stunting of plants. Soybean yields were extremely low due to excessive rainfall around harvest time.

Table 1. Centennial soybean response to herbicides applied preemergence (PE) and postemergence over-the-top (POT). Rice Research Station, Crowley, LA. 1985.

Treatment	Application method	Rate	Plants/ 3 ft row	Phytotoxicity (%)			Plant Pod		Yield
				6/5	7/3	7/22	ht	ht	
		(lb ai/A)	(no.)	------(%)-----			---(in)---		(bu/A)
Sencor	PE	0.38	23	6	0	0	29	4	36.1
	PE	0.50	25	10	1	1	29	4	39.6
Scepter	PE	0.13	23	9	8	4	27	4	38.3
	PE	0.25	22	23	25	23	24	3	35.3
	PE	0.38	23	26	27	23	22	4	36.7
Canopy	PE	0.38	24	3	3	0	30	4	38.8
		0.50	25	6	3	0	28	4	36.1
Scepter fb	PE	0.13	24	10	10	10	28	4	36.0
Scepter	POT	0.13							
Scepter fb	PE	0.13	23	10	8	10	26	4	38.5
Scepter	POT	0.25							
Canopy fb	PE	0.38	23	8	8	4	28	4	35.8
Classic	POT	0.008							
Canopy fb	PE	0.38	24	3	9	8	26	4	35.8
Classic	POT	0.016							
Command	PE	1.50	25	4	1	0	29	4	42.3
	PE	2.00	23	8	3	1	30	4	35.6
AC 263,499	PE	0.13	26	0	0	0	31	4	37.4
	PE	0.25	25	1	0	0	30	4	39.4
Lorox	PE	0.75	22	1	0	0	29	5	38.6
R 8259	PE	0.75	22	3	1	1	31	5	38.2
	PE	1.13	23	8	6	1	29	4	38.8
DPX F6025	PE	0.063	29	1	0	0	31	3	41.6
	PE	0.094	19	5	5	3	30	4	37.0
Check	---	---	21	0	0	0	30	4	38.3
LSD (0.05)			NS	7	8	7	3	1	NS

Table 2. Centennial soybean response to herbicides applied postemergence over-the-top. Rice Research Station, Crowley, LA. 1985.^{1/}

Herbicide	Rate of application (lb ai/A)	Phytotoxicity		Plant height ----- (in) -----	Pod height ----- (in) -----	Yield (bu/A)
		7/3	7/22			
		----- (%) -----				
Scepter	0.19	2	1	32	4	19.9
	0.25	6	2	30	4	20.8
Classic	0.008	6	2	32	4	18.5
	0.016	6	1	31	4	18.5
Cobra	0.20	8	2	29	4	17.3
	0.30	6	1	32	4	20.2
Reflex	0.38	5	2	31	4	19.5
Basagran + Blazer	0.50 + 0.25	6	2	30	4	15.5
Blazer	0.50	7	2	31	4	17.4
Basagran	1.00	3	1	31	4	17.5
Blazer + 2,4-DB	0.50 + 0.03	7	0	31	4	18.4
2,4-DB	0.03	4	3	32	4	16.7
	0.06	6	1	31	4	19.7
AC 263,499	0.06	3	1	31	4	17.9
	0.13	3	3	33	4	22.0
Dyanap	0.50	7	1	31	4	20.4
Control	---	0	2	30	3	18.9
LSD (0.05)		NS	NS	NS	NS	NS

^{1/} Means represent an average for herbicide application at V2 and V4 growth stages.

SOYBEAN WEED CONTROL STUDIES

(A Progress Report)

J.L. Griffin, R.J. Habetz, and R.P. Regan

INTRODUCTION

In the rice area of southwest Louisiana red rice (Oryza sativa L.) can be a major problem in both rice and soybeans. Severe red rice competition can reduce both yields and quality of grain marketed. Since the majority of the soybeans in the rice area are solid-seeded, the option of postemergence-directed herbicide application is not available. Therefore, producers must rely on preemergence herbicides followed by a postemergence overtop application if needed. Studies were conducted to evaluate potential preemergence and postemergence herbicides for control of red rice, itchgrass (Rottboellia exaltata L.) and other annual grasses as well as problem broadleaf weeds in a soybean cropping system.

RED RICE PREPLANT INCORPORATED TEST

MATERIALS AND METHODS

Labeled preemergence chloroacetanilide herbicides alachlor (Lasso) and metolachlor (Dual), dinitroaniline herbicides trifluralin (Treflan) and pendimethalin (Prowl), and Scepter, AC 263,499, Command, DPX F6025, Cinch, RE-39571, and CGA 24704 were evaluated for red rice control. Chemical treatments were applied in 22 gal/A spray volume at 26 psi pressure and incorporated with a spring-tooth field cultivator prior to planting 'Ransom' soybeans on June 25. Soybeans were planted on 30-in row spacings and fertilizer was broadcasted and incorporated prior to planting at a rate of 0-60-60 lb/A (N-P₂O₅-K₂O). Red rice control ratings were made on July 29. A randomized complete block design with four replications was used. Plot size was 10 x 25 ft (four 30-in rows) and the two inside rows were treated.

RESULTS AND DISCUSSION

Red rice control, in general, was lower than previous years due to extremely dry conditions following herbicide application. Red rice control for all herbicide treatments was less than 90% (Table 1). Dual, Lasso, Prowl plus Lasso MT, Prowl plus Dual, CGA 24704 at both rates, and Scepter provided at least 80% control. Tank mixes of Prowl plus Lasso MT or Dual gave red rice control higher than Prowl applied alone but similar to that of Lasso and Dual. Red rice control was less than 50% for RE-39571 at both rates and Verdict. Soybean injury was minimal for all herbicide treatments.

Table 1. Efficacy of several preplant incorporated herbicides on red rice in soybeans. Rice Research Station, Crowley, LA. 1985.

Treatment	Rate	Red rice control ^{1/}
	(lb ai/A)	------(%)-----
Dual	2.00	85
Lasso	3.00	89
Lasso MT	3.00	79
Prowl	1.50	65
Prowl + Lasso MT	1.0 + 2.0	80
Prowl + Dual	1.0 + 1.0	80
Treflan	1.50	55
Cinch	1.00	58
	1.50	70
RE-39571	1.00	40
	1.50	48
CGA 24704	1.50	83
	2.00	83
Scepter	0.25	80
AC 263,499	0.13	75
Command	1.50	53
DPX F6025	0.063	53
Verdict	0.25	40
LSD (0.05)		11

^{1/} Ratings made on July 29 (34 DAT).

RED RICE POSTEMERGENCE OVERTOP TEST

MATERIALS AND METHODS

Ransom soybeans were planted on 30-in row spacings on June 25. Sethoxydim (Poast), fluazifop (Fusilade 2000), haloxyfop (Verdict), Assure, SC 1084, Scepter, mefluidide + bentazon (Embark + Basagran), Classic and Selectone were applied postemergence overtop on July 8 when red rice was less than 4 inches in height at the 2- to 3-leaf stage. Herbicides were applied in 22 gal/A spray volume at 26 psi pressure. Soybeans at the time of application were at the V2 (one fully expanded trifoliate) growth stage and 4 inches in height. A 1.0% (v/v) oil concentrate was applied with all treatments except Scepter (no adjuvant) and Embark + Basagran which had 0.25% (v/v) Ag 98 added. Red rice control ratings were made on July 29. A randomized complete block design with four replications was used.

RESULTS AND DISCUSSION

Red rice control ratings were 85% or more for Scepter, AC 263,499, and Assure at both rates, Selectone at 0.38 lb/A, and Embark plus Basagran (Table 2). Control was significantly increased as rate increased for Poast and SC 1084. Red rice control for Scepter and AC 263,499 was similar to the Embark + Basagran tank mix. Classic at both rates tested provided poor red rice control. Soybean injury was minimal for all treatments.

Table 2. Efficacy of several postemergence overtop herbicides on red rice in soybeans. Rice Research Station, Crowley, LA. 1985.

Treatment ^{1/}	Rate (lb ai/A)	Red rice control ^{2/} ------(%)-----
Poast	0.25	54
	0.38	70
Scepter	0.25	94
AC 263,499	0.13	95
Fusilade 2000	0.19	64
	0.25	74
Verdict	0.18	70
	0.25	76
Assure	0.09	85
	0.13	89
Selectone	0.25	79
	0.38	89
SC 1084	0.25	64
	0.38	75
Embark + Basagran	0.13 + 0.75	91
Classic	0.008	63
	0.016	50
LSD (0.05)		11

^{1/} All treatments had 1.0% (v/v) Agridex added except Scepter (no adjuvant) and Embark + Basagran which had 0.25% (v/v) Ag 98 added.

^{2/} Ratings made on July 29 (21 DAT).

RED RICE TANK MIX TEST

MATERIALS AND METHODS

These studies were conducted to evaluate red rice control using tank mixes of Lasso or Dual with Scepter and Canopy. Previous studies have indicated fair to good red rice control using Scepter and Canopy alone. Since both Lasso and Dual provide consistently good to excellent red rice control, it was felt that possible synergism of the tank mix may allow for reduction in the Lasso/Dual rate. Ransom soybeans were planted on June 25 on 30-in row spacings. Fertilizer was broadcasted and incorporated prior to planting at a rate of 0-60-60 lb/A (N-P₂O₅-K₂O). Preemergence herbicide treatments were incorporated with a spring-tooth field cultivator prior to planting. All treatments were applied in 22 gal/A spray volume at 26 psi pressure. Red rice control ratings were made on July 29, August 28, and October 11. A randomized complete block design with four replications was used. Plot size was 10 x 25 ft (four 30-in rows) and the two inside rows were treated.

RESULTS AND DISCUSSION

Red rice control ratings for individual herbicide treatments were similar for the three rating dates (Table 3). A significant difference in control rating among the herbicide treatments was noted for only the July 29 rating date. In general, increasing the Scepter rate to 0.25 lb/A in the Lasso MT or Dual tank mixes did not increase red rice control over the same rates of Lasso MT and Dual plus Scepter at 0.13 lb/A. For both Lasso MT and Dual, red rice control did not change with increasing rate regardless of the Scepter rate used. Lasso MT plus Canopy gave similar red rice control to that noted for Lasso MT (at comparable rates) plus Scepter at 0.13 lb/A. Red rice control, however, was lower for Lasso MT plus Canopy when compared to Lasso MT at the same rates tank mixed with Scepter at 0.25 lb/A. Dual plus Canopy provided similar red rice control to that noted for the Dual plus Scepter tank mixes. Red rice control in general was lower than that observed in previous years primarily due to dry conditions following herbicide application. Canopy and Scepter alone provided at least 80% control. Further studies will be needed to determine if rates of Lasso and Dual can be reduced when tank mixed with Scepter or Canopy.

Table 3. Red rice control in soybeans using preplant incorporated tank mixes of Lasso MT or Dual with Scepter or Canopy. Rice Research Station, Crowley, LA. 1985.

Treatment	Rate	Red rice control ^{1/}		
		7/29	8/28	10/11
	(lb ai/A)	------(%)-----		
Lasso MT + Scepter	2.0 + 0.13	80	80	78
	2.5 + 0.13	80	83	78
	3.0 + 0.13	83	84	83
	2.0 + 0.25	85	85	85
	2.5 + 0.25	88	88	88
	3.0 + 0.25	89	88	85
Lasso MT + Canopy	2.0 + 0.38	76	78	78
	2.5 + 0.38	81	81	76
	3.0 + 0.38	84	85	80
Dual + Scepter	1.0 + 0.13	80	79	78
	1.5 + 0.13	83	84	80
	2.0 + 0.13	84	86	81
	1.0 + 0.25	85	85	84
	1.5 + 0.25	83	88	85
	2.0 + 0.25	83	86	84
Dual + Canopy	1.0 + 0.38	85	81	80
	1.5 + 0.38	79	79	79
	2.0 + 0.38	85	86	85
Canopy	0.38	86	85	85
Scepter	0.25	80	83	80
LSD (0.05)		6	NS	NS

^{1/} Ratings made on July 29 (34 DAT), August 28 (64 DAT) and October 11 (108 DAT).

RED RICE WEED CONTROL OPTION TEST

MATERIALS AND METHODS

Lasso (3.5 lb/A) and Dual (2.5 lb/A) were shallow incorporated using a spring-tooth field cultivator prior to planting Ransom soybeans on June 25. Red rice collected from Kinder, LA was seeded and incorporated prior to planting soybeans. Fertilizer was broadcasted and incorporated prior to planting at a rate of 0-60-60 lb/A ($\text{N-P}_2\text{O}_5\text{-K}_2\text{O}$). Poast (0.25 and 0.50 lb/A), Fusilade 2000 and Verdict (0.13 and 0.25² lb/A), Assure (0.06 and 0.13 lb/A), and Embark + Basagran (0.13 + 0.75 lb/A) were applied postemergence overtop on July 8 when red rice was at the 2- to 3-leaf stage (<4 inch height) and when soybeans were at the V2 (first trifoliate) growth stage and 4 inches in height. All herbicide treatments were applied in 22 gal/A spray volume at 26 psi pressure. A preemergence herbicide was not applied prior to the application of the postemergence treatments. Red rice control ratings were made on July 29, August 28, and October 11. Red rice biomass estimates were determined by hand harvesting two areas (4 ft²) from each plot at soybean maturity. Biomass samples were dried in a forced-draft oven at 60°C for 72 hours to determine dry matter production. A randomized complete block design with four replications was used. Plot size was 10 x 25 ft (four 30-in rows) and the two inside rows were treated.

RESULTS AND DISCUSSION

On all rating dates, red rice control was similar for Lasso and Dual and control did not change as the season progressed (Table 4). In addition, red rice control rating for individual postemergence herbicide treatments were similar for the three rating dates. Red rice control increased significantly as herbicide rate increased for all rating dates. On the October 11 rating date, treatments providing at least 80% red rice control were Dual, Assure at 0.13 lb/A, and Embark + Basagran. The higher red rice control ratings generally corresponded to lower red rice biomass production. Red rice biomass was significantly reduced as herbicide rates increased for all postemergence herbicide treatments.

Results indicate that use of preemergence herbicides, as compared to only a postemergence application, appears more viable since the herbicide is present in the zone where the weed seed germinate thereby aiding in reducing early season competition. In addition, weed control obtained from use of only a postemergence overtop herbicide would be greatly dependent on proper timing of application. Such environmental factors as rainfall and temperature could greatly affect herbicide efficacy. Red rice seed production where a total postemergence control program is used would assure future problems particularly where the subsequent crop is rice. Overall, use of a preemergence herbicide followed by a postemergence overtop application if needed would present the best weed control option.

Table 4. Control of red rice in soybeans using preplant incorporated (PPI) and postemergence overtop (POT) herbicides. Rice Research Station, Crowley, LA. 1985.

Treatment	Rate	Application method ^{1/}	Red rice control			Red rice biomass produced
			7/29	8/28	10/11	
	(lb ai/A)		------(%)-----			(g DM/ft ²)
Dual	2.5	PPI	85	85	83	9.7
Lasso	3.5	PPI	79	75	73	13.4
Poast	0.25	POT	54	45	40	21.3
	0.50	POT	84	80	76	5.2
Fusilade 2000	0.13	POT	43	33	33	23.0
	0.25	POT	84	81	76	7.4
Verdict	0.13	POT	33	30	25	23.8
	0.25	POT	80	76	74	7.1
Assure	0.06	POT	78	75	74	12.4
	0.13	POT	93	93	93	1.4
Embark + Basagran	0.13 + 0.75	POT	93	88	88	4.7
Check-no herbicide	--	---	0	0	0	25.6
LSD (0.05)			10	12	13	7.7

^{1/} Preplant herbicides applied 6/25; post-herbicides applied 7/8 - red rice <4 inch at 3- to 4-leaf stage. Postemergence treatments had 1.0% (v/v) Agridex added except Embark + Basagran which had 0.25% (v/v) Ag 98 added.

ITCHGRASS PREPLANT-INCORPORATED TEST

MATERIALS AND METHODS

Centennial soybeans were planted on the Leonard Habetz Farm near Crowley, LA, on May 31. Fertilizer was banded at planting at a rate of 0-40-40 lb/A (N-P₂O₅-K₂O). Treflan, Prowl, Lasso MT, Dual, Command, CGA 24704, Cinch, RE-39571, Scepter, AC 263,499, and Canopy were applied just prior to planting in 22 gal/A spray volume at 26 psi pressure and incorporated with two passes of a vibra-shank with a cultipacker behind. Other implements which would have provided a more uniform incorporation were not available. Itchgrass control ratings were made on July 2 and 22. A randomized complete block design with three replications was used. Plot size was 10 x 25 ft (four 30-in rows) and the two inside rows were treated.

RESULTS AND DISCUSSION

Itchgrass control on the later rating date (July 22) was lower than that observed on the early rating date (July 2) for most herbicide treatments (Table 5). Control on July 22 was at least 85% for Treflan at 1.5 and 2.0 lb/A, and for Prowl at 1.5 lb/A. All other herbicide treatments gave significantly lower itchgrass control than that noted for Treflan and Prowl. Tank mixes of Prowl plus Dual or Lasso MT provided itchgrass control comparable to Prowl applied alone at the same rate. Treatments providing extremely poor itchgrass control

Table 5. Efficacy of several preplant incorporated herbicides on itchgrass in soybeans. L. Habetz Farm, Crowley, LA. 1985.

Treatment	Rate (lb ai/A)	Itchgrass control ^{1/}	
		7/2	7/22
		------(%)-----	
Treflan	1.0	82	65
	1.5	93	88
Prowl	1.0	77	68
	1.5	90	85
Lasso MT	3.0	25	17
Treflan	2.0	95	93
Dual	2.0	38	17
Prowl + Dual	1.0 + 1.5	78	68
Prowl + Lasso MT	1.0 + 2.5	72	53
Command	1.5	65	40
CGA 24704	2.0	33	13
Cinch	1.5	73	55
RE-39571	1.5	30	7
Scepter	0.25	45	27
Canopy	0.38	27	7
AC 263,499	0.13	33	20
Check	---	0	0
LSD (0.05)		17	17

^{1/} Ratings made on 7/2 (32 DAT) and 7/22 (52 DAT).

(less than 30%) were Lasso MT, Dual, CGA 24704, RE-39571, Scepter, Canopy, and AC 263,499. Results indicate that even under less than optimum incorporation, good itchgrass control was obtained with 2X rates (for silt loam soil) of Treflan and Prowl. Depending on the degree of itchgrass population, a follow-up postemergence overtop application may be needed.

ITCHGRASS POSTEMERGENCE OVERTOP TEST

MATERIALS AND METHODS

Centennial soybeans were planted on May 31 on the Leonard Habetz Farm near Crowley, LA. Soybeans were planted on 30-in row spacings and fertilizer was banded at a rate of 0-40-40 lb/A (N-P₂O₅-K₂O). Fusilade, Fusilade 2000, Poast, Verdict, Assure, Selectone, SC 1084, Scepter, AC 263,499, Classic, and Hoelon were applied postemergence overtop on June 24 when itchgrass was approximately 6 inches in height and broadleaf signalgrass [*Bracharia platyphylla* (Griseb.) Nash.] was approximately 4 inches in height. Soybeans at the time of application were at the V4 (three fully expanded trifoliates) and 8 inches in height. Herbicides were applied in 22 gal/A spray volume at 26 psi pressure. A 1.0% (v/v) of Agridex was applied with all treatments except Scepter (no adjuvant), and AC 263,499 Classic, and Hoelon which had 0.25% (v/v) Ag 98

added. Both itchgrass and broadleaf signalgrass ratings were made on July 22 and itchgrass rating was made again on October 10. A randomized complete block design with three replications was used. Plot size was 10 x 25 ft and 6 ft were treated.

RESULTS AND DISCUSSION

Itchgrass control on October 10 was excellent (at least 95%) for Fusilade at 0.25 and 0.38 lb/A, Fusilade 2000 and Verdict at 0.19 and 0.25 lb/A, Assure at 0.09 and 0.13 lb/A, and Hoelon at 1.00 lb/A (Table 6). Poast, Selectone, and SC 1084 provided 40 to 50% control and Scepter, AC 263,499, and Classic gave essentially no control. Broadleaf signalgrass was also present in the experimental area and control was excellent for most herbicides except Fusilade and Poast at 0.25 lb/A, Selectone and SC 1084 at 0.25 and 0.38 lb/A and Scepter, AC 263,499, Classic, and Hoelon. Results indicate that in fields with both itchgrass and broadleaf signalgrass present, the most consistent and most

Table 6. Efficacy of several postemergence overtop herbicides on itchgrass and broadleaf signalgrass in soybeans. L. Habetz Farm, Crowley, LA. 1985.

Treatment ^{1/}	Rate	Itchgrass control ^{2/}		Broadleaf signalgrass control ^{2/}
		7/22	10/10	7/22
	(lb ai/A)	----- (%) -----		
Fusilade	0.25	98	95	82
	0.38	100	98	93
Fusilade 2000	0.19	100	97	92
	0.25	98	95	95
Poast	0.25	75	47	80
	0.38	83	45	90
Verdict	0.19	100	98	97
	0.25	100	98	97
Assure	0.09	98	97	93
	0.13	100	95	95
Selectone	0.25	53	20	57
	0.38	75	37	80
SC 1084	0.25	73	40	75
	0.38	85	63	85
Scepter	0.13	27	3	27
	0.25	37	20	33
AC 263,499	0.06	27	13	27
	0.13	47	13	47
Classic	0.008	0	0	0
	0.016	13	0	13
Hoelon	1.00	100	98	0
LSD (0.05)		11	15	11

^{1/} All treatments had 1.0% (v/v) Agridex except Scepter (no adjuvant), and AC 263,499, Classic and Hoelon which had 0.25% (v/v) Ag 98 added.

^{2/} Ratings made on July 22 (28 DAT) and October 10 (108 DAT).

economical treatments would include Fusilade at 0.38 lb/A, Fusilade 2000 and Verdict at 0.19 lb/A, Assure at 0.09 lb/A lb/A. Use of Hoelon would be unacceptable if grasses other than itchgrass were present.

MORNINGGLORY PRE- AND POSTEMERGENCE TESTS

MATERIALS AND METHODS

Centennial soybeans were planted on 30-in row spacings on May 27 at the Rice Research Station. Fertilizer at the rate of 0-40-40 lb/A ($N-P_{205}-K_{20}$) was banded at planting. Preemergence (PE) herbicides, metribuzin, Scepter, AC 263,499, Canopy, DPX F6025, Lorox, R 8259, and Command were surface applied after planting. Postemergence herbicides Scepter, AC 263,499, Classic, Blazer, RH-0265, Cobra, PPG 1013, and Reflex were applied postemergence overtop (POT) on June 14. All herbicide treatments were applied in 22 gal/A spray volume at 26 psi pressure. Pitted (*Ipomoea lacunosa* L.) morningglory was at the 2- to 4-leaf growth stage and 2 to 3 inches in height and soybeans were at the V2 to V3 (1 to 2 fully expanded trifoliates) growth stage and 6 inches in height when the postemergence herbicides were applied. Postemergence treatments were applied before rainfall was received to activate the PE treatment. Weed control and soybean injury ratings were made on July 2. Two studies, a PE or PE followed by POT and POT only, were conducted. A randomized complete block design with four replications was used in each study. Plot size was 10 x 25 ft (four 30-inch rows) and the two inside rows were treated.

RESULTS AND DISCUSSION

In the first study, morningglory control ratings were 85% or more for only the Scepter PE/POT and the Canopy/Classic PE/POT sequential treatments (Table 7). The AC 263,499 PE/POT sequential treatment, as well as the Command PE treatment at 1.50 lb/A, provided 83% morningglory control. All other treatments provided poor morningglory control partially due to the extremely dry condition following preemergence applications. The good control for the sequential treatments as compared to the single PE treatment indicates that efficacy was primarily due to the POT treatment. Addition of the synergist MZH 2091 to metribuzin did not increase morningglory activity over metribuzin applied alone. AC 263,499 at 0.06 and 0.13, DPX F6025 at 0.047, and Lorox and R 8259 at 0.75 lb/A provided morningglory control similar to that of metribuzin. The enhanced activity of Command applied PE at 1.25 and 1.50 lb/A indicates that rainfall activation may be less critical than that for the other PE herbicide treatments. Soybean injury was not observed for any of the treatments.

In the second study where herbicide was applied POT, morningglory control on July 2 was similar for all herbicide treatments evaluated, averaging 80% (Table 8). Phytotoxicity on soybeans from Blazer, Cobra, and PPG 1013 consisted primarily of leaf burn. Scepter, Classic, and Reflex showed no visible injury. By the time ratings were made on July 2 (18 DAT) visible injury was not observed for any of the herbicide treatments.

Table 7. Efficacy of several herbicides applied preemergence (PE) and postemergence overtop (POT) on morningglory. Rice Research Station, Crowley, LA. 1985.^{1/}

Treatment ^{2/}	Application method ^{3/}	Rate (lb ai/A)	Morningglory control	Soybean injury
			7/2 ----- (%) -----	
Metribuzin	PE	0.38	23	0
Metribuzin + MZH 2091	PE	0.38 + 0.38	31	0
Scepter	PE	0.13	53	0
Scepter/Scepter	PE/POT	0.13/0.13	86	0
AC 263,499	PE	0.06	35	0
	PE	0.13	40	0
AC 263,499/AC 263,499	PE/POT	0.06/0.06	83	0
Canopy	PE	0.38	46	0
Canopy/Classic	PE/POT	0.38/0.008	95	0
DPX F6025	PE	0.047	35	0
	PE	0.063	43	0
Lorox	PE	0.75	35	0
R 8259	PE	0.75	48	0
Command	PE	1.25	70	0
	PE	1.50	83	0
LSD (0.05)			17	NS

^{1/} Pitted morningglory (*Ipomoea lacunosa*) was the primary species present.

^{2/} Nonionic surfactant (Ag 98) added at 0.25% (v/v) to AC 263,499 and Classic POT treatments.

^{3/} PE herbicides applied 5/27; POT herbicides applied 6/14.

Table 8. Efficacy of several herbicides applied postemergence overtop on morningglory. Rice Research Station, Crowley, LA. 1985.^{1/}

Treatment	Rate (lb ai/A)	Morningglory control 7/2	Soybean injury
		----- (%) -----	
Blazer ^{2/}	0.50	96	0
RH-0265	0.18	85	0
	0.25	89	0
Scepter + Blazer	0.13 + 0.19	91	0
Classic ^{2/} + Blazer ^{2/}	0.008 + 0.19	93	0
Classic ^{2/}	0.008	92	0
	0.016	92	0
Scepter	0.19	84	0
	0.25	88	0
Reflex ^{2/}	0.25	88	0
	0.38	92	0
Cobra ^{2/}	0.20	76	0
PPG 1013 ^{2/}	0.04	69	0
LSD (0.05)		NS	NS

^{1/} Pitted morningglory (Ipomoea lacunosa) was the the primary species present.

^{2/} Nonionic surfactant (Ag 98) added at 0.25% (v/v); all herbicide treatments applied 6/14.

WILD POINSETTIA PRE- AND POSTEMERGENCE TESTS

MATERIALS AND METHODS

Centennial soybeans were planted on 30-in row spacings on May 27 at the J. Heinen Farm, Crowley, La. Preemergence (PE) herbicides including metribuzin, Canopy, Scepter, Classic, DPX F6025, AC 263,499, Lorox, R 8259, and Command were surface applied after planting. Postemergence herbicides Scepter, Classic, and AC 263,499 were applied overtop (POT) on June 26. All herbicide treatments were applied in 22 gal/A spray volume at 26 psi pressure. Wild poinsettia (Euphorbia heterophylla L.) was at the 2- to 3-leaf stage and 2 inches in height and soybeans were at the V4 to V5 (three to four fully expanded trifoliates) growth stage and 10 to 12 inches in height when the postemergence herbicides were applied. In another study, only postemergence herbicides Blazer, RH-0265, Scepter, Classic, Cobra, PPG 1013, Reflex, and Basagran were evaluated. Centennial soybeans were planted on May 21 on 30-in row spacings at the J. Heinen Farm. When herbicide treatments were applied, wild poinsettia was at 4-leaf stage and 2 to 3 inches in height and soybeans were at V2 to V3 (one to two fully expanded trifoliates) and 5 inches in height. Weed control and soybean injury ratings were made on July 2 and August 28 for both studies. In addition, control ratings were made on October 11 for the PE/POT sequential study. A randomized complete block design with four

replications (PE/POT sequential study) and three replications (POT study) was used. Plot size was 10 x 25 ft (four 30-in rows) and the two inside rows were treated.

RESULTS AND DISCUSSION

Rainfall was not received until 3 weeks after planting. In the first study, wild poinsettia control on October 11 was less than 50% for metribuzin at 0.38 lb/A, metribuzin + MZH 2091 at 0.38 + 0.38 lb/A, Canopy at 0.25 and 0.38 lb/A, DPX F6025 at 0.047 and 0.063 lb/A, and Lorox and R 8259 at 0.75 lb/A (Table 9). Scepter applied PE at 0.13 and 0.25 lb/A provided 68 and 83% wild poinsettia control, respectively. Control where Scepter was applied sequentially was similar to Scepter applied PE at 0.25 lb/A. AC 263,499 applied at 0.06 and 0.13 lb/A provided wild poinsettia control comparable to the Scepter PE treatment at 0.25 lb/A and the Scepter sequential treatment. The AC 263,499, Canopy/Classic, and DPX F6025/Classic sequential treatments gave at least 95% wild poinsettia control. Canopy applied PE at 1.25 and 1.50 lb/A

Table 9. Efficacy of several herbicides applied preemergence (PE) and post-emergence overtop (POT) on wild poinsettia. J. Heinen Farm, Crowley, LA. 1985.

Treatment ^{1/}	Application method ^{2/}	Rate	Wild poinsettia control		
			7/2	8/28	10/11
		(lb ai/A)	----- (%) -----		
Metribuzin	PE	0.38	30	20	17
Metribuzin + MZH 2091	PE	0.38 + 0.38	20	20	20
Canopy	PE	0.25	68	40	33
	PE	0.38	52	47	47
Canopy/Classic	PE/POT	0.38/0.008	95	95	95
DPX F6025	PE	0.047	68	25	25
	PE	0.063	77	27	30
DPX F6025/Classic	PE/POT	0.063/0.008	95	95	95
Scepter	PE	0.13	75	68	68
	PE	0.25	83	83	83
Scepter/Scepter	PE/POT	0.13/0.13	80	85	88
AC 263,499	PE	0.06	73	87	88
	PE	0.13	83	92	92
AC 263,499/AC 263,499	PE/POT	0.06/0.06	78	98	98
Lorox	PE	0.75	57	20	20
R 8259	PE	0.75	73	25	30
Command	PE	1.25	95	97	98
	PE	1.50	97	95	97
LSD (0.05)			19	13	15

^{1/} Nonionic surfactant (Ag 98) added at 0.25% (v/v) to Classic and AC 263,499 POT treatments.

^{2/} PE herbicides applied 5/27; POT herbicides applied 6/24.

provided 98% control. The excellent control with Command indicates that rain-fall requirement for activation may be less critical than that needed for other PE herbicide treatments.

In the POT study, wild poinsettia control for most herbicide treatments was much lower on the August 28 rating date compared to July 2 (Table 10). The lower control ratings were related primarily to a new flush of weeds following application rather than weed regrowth. Wild poinsettia control on August 28 was less than 80% for all treatments except Scepter at 0.19 and 0.25 lb/A and AC 263,499 at 0.13 lb/A. Addition of 2,4-DB to Blazer and RH-0265 did not increase control over using Blazer and RH-0265 alone. Blazer plus Basagran provided similar control to that of Blazer alone. Scepter and Classic tank mixed with Blazer gave similar control to that of Scepter and Classic alone. The Scepter plus Blazer tank mix, however, provided higher control than that noted for Blazer alone. Addition of oil concentrate to Cobra and PPG 1013 did not enhance herbicide activity over using the herbicides with a nonionic surfactant.

Table 10. Efficacy of several herbicides applied postemergence overtop on wild poinsettia. J. Heinen Farm, Crowley, LA. 1985.

Treatment ^{1/}	Rate (lb ai/A)	Wild poinsettia control	
		7/2	8/28
		------(%)-----	
Blazer	0.50	93	45
Blazer + 2,4-DB	0.50 + 0.03	93	57
RH-0265	0.18	85	37
	0.25	87	47
RH-0265 + 2,4-DB	0.12 + 0.03	83	43
	0.18 + 0.03	83	33
Scepter	0.19	87	83
	0.25	93	83
Scepter + Blazer	0.13 + 0.19	90	70
Classic	0.008	90	47
	0.016	87	50
Classic + Blazer	0.008 + 0.19	93	43
Cobra	0.20	95	68
Cobra + oil conc. (1.0% v/v)	0.20	90	50
PPG 1013	0.04	95	57
PPG 1013 + oil conc. (1.0% v/v)	0.04	95	67
Reflex	0.25	80	48
	0.38	93	50
Blazer + Basagran	0.25 + 0.50	95	58
AC 263,499	0.06	90	62
	0.13	95	93
LSD (0.05)		NS	23

^{1/} Nonionic surfactant (Ag 98) added at 0.25% (v/v) to all treatments except Scepter, RH-0265, and Cobra and PPG 1013 + oil concentrate; herbicides applied 6/6.

HEMP SESBANIA AND SICKLEPOD PRE- AND POSTEMERGENCE TESTS

MATERIALS AND METHODS

Centennial soybeans were planted on 30-in row spacings on June 17 at the Rice Research Station, Crowley, LA. Preemergence (PE) herbicides including metribuzin, Scepter, Classic, Canopy, DPX F6025, AC 263,499, Lorox, R 8259, and Command were surface applied after planting. Postemergence herbicides Scepter, Classic, Blazer, RH-0265, AC 263,499, Cobra, PPG 1013, and Reflex were applied overtop (POT) on July 8. All herbicides were applied in 22 gal/A spray volume at 26 psi pressure. Hemp sesbania was at the 5-leaf stage and 4 inches in height, sicklepod was at the 3- to 4-leaf stage and 3 inches in height, and soybeans were at the V3 (two fully expanded trifoliates) growth stage and 6 inches in height when the postemergence herbicides were applied. Weed control ratings were made on July 30. Two studies, a PE or PE followed by POT and POT only, were conducted. A randomized complete block design with four replications was used for each study. Plot size was 10 x 25 ft (four 30-in rows) and the two inside rows were treated.

RESULTS AND DISCUSSION

Significant rainfall (3.7 inches) was received within the 3-day period following PE herbicide application. Hemp sesbania control was at least 90% for metribuzin at 0.38 lb/A, Canopy at 0.25 and 0.38 lb/A, Lorox and R 8259 at 0.75 lb/A and for the Canopy/Classic and DPX F6025/Classic PE/POT sequential treatments (Table 11). Scepter at 0.13 and 0.25 lb/A and AC 263,499 at 0.06 and 0.13 lb/A applied PE gave poor hemp sesbania control. The Scepter and AC 263,499 sequential treatments provided 80 and 43% hemp sesbania control, respectively. Command provided less than 75% hemp sesbania control. Sicklepod control on July 30 was at least 90% for metribuzin and Canopy at 0.38 lb/A, Command at 1.25 and 1.50 lb/A, and Canopy/Classic and DPX F6025/Classic PE/POT sequential treatments. Preemergence applications of DPX F6025, Scepter, AC 263,499, Lorox, and R8259 and PE/POT sequential applications of AC 263,499 provided poor control. The Scepter sequential treatment gave 76% sicklepod control. In general, sicklepod control was higher than that observed for previous years for metribuzin and Canopy but lower than that for the Scepter treatments. The higher control in 1985 was probably related to the ideal rainfall conditions which activated the herbicides possibly enhancing the activity of metribuzin. Soybean injury was minimal for all treatments.

In the postemergence study at least 90% hemp sesbania control was obtained with Blazer at 0.50 lb/A, RH-0265 at 0.25 lb/A, Classic at 0.008 and 0.016 lb/A, PPG 1013 at 0.04 lb/A, and Reflex at 0.38 lb/A (Table 12). Addition of 2,4-DB at 0.03 lb/A to Blazer and RH-0265 did not increase control over Blazer and RH-0265 applied alone. Scepter at 0.25 lb/A provided only 82% hemp sesbania control and AC 263,499 at 0.13 lb/A gave poor control. In contrast, sicklepod control was more than 90% for only Classic at 0.016 lb/A. Sicklepod control was 84% for Classic at 0.008 lb/A. Scepter at both 0.19 and 0.25 lb/A provided 76% sicklepod control. Poor sicklepod control was obtained with the other POT herbicide treatments. Soybean injury was minimal for all herbicide treatments.

Table 11. Efficacy of several herbicides applied preemergence (PE) and post-emergence overtop (POT) on hemp sesbania and sicklepod. Rice Research Station, Crowley, LA. 1985.

Treatment ^{1/}	Application method ^{2/}	Rate	Control	
			Hemp sesbania 7/30	Sicklepod 7/30
		(lb ai/A)	----- (%) -----	
Metribuzin	PE	0.38	97	95
Metribuzin + MZH 2091	PE	0.38 + 0.38	98	97
Canopy	PE	0.25	93	89
	PE	0.38	98	94
Canopy/Classic	PE/POT	0.38/0.008	100	95
DPX F6025	PE	0.047	67	45
	PE	0.063	58	35
DPX F6025/Classic	PE/POT	0.063/0.008	98	90
Scepter	PE	0.13	37	49
	PE	0.25	60	60
Scepter/Scepter	PE/POT	0.13/0.13	80	76
AC 263,499	PE	0.06	33	35
	PE	0.13	37	53
AC 263,499/AC 263,499	PE/POT	0.06/0.06	43	38
Lorox	PE	0.75	95	30
R 8259	PE	0.75	95	61
Command	PE	1.25	55	94
	PE	1.50	73	95
LSD (0.05)			22	17

^{1/} Nonionic surfactant (Ag 98) added at 0.25% (v/v) to Classic and AC 263,499 POT treatments.

^{2/} PE herbicides applied 6/17; POT herbicides applied 7/8.

Table 12. Efficacy of several herbicides applied postemergence ovetop on hemp sesbania and sicklepod. Rice Research Station, Crowley, LA. 1985.

Treatment	Rate	Control	
		Hemp sesbania 7/30	Sicklepod 7/30
	(1b ai/A)	------(%)-----	
Blazer ^{1/}	0.50	97	53
Blazer + 2,4-DB ^{1/}	0.50 + 0.03	95	63
RH-0265	0.25	90	44
RH-0265 + 2,4-DB	0.18 + 0.03	83	50
Scepter	0.19	72	76
	0.25	82	76
Classic ^{1/}	0.008	95	84
	0.016	97	91
Cobra ^{1/}	0.20	87	55
PPG 1013 ^{1/}	0.04	92	48
Reflex ^{1/}	0.38	95	61
AC 263,499 ^{1/}	0.13	43	44
LSD (0.05)		10	23

^{1/} Nonionic surfactant (Ag 98) added at 0.25% (v/v); all herbicide treatments applied 7/8.

MEXICANWEED PRE- AND POSTEMERGENCE TESTS

MATERIALS AND METHODS

Mexicanweed control was evaluated using PE herbicides, metribuzin, Canopy, Classic, DPX F6025, Scepter, AC 263,499, Lorox, R 8259, and Command at the T. Faulk Farm, Crowley, LA. In addition, postemergence herbicides Blazer, RH-0265, Scepter, Classic, Cobra, PPG 1013, Reflex, Basagran, and AC 263,499 were evaluated in a separate study. All herbicide treatments were applied in 22 gal/A spray volume at 26 psi pressure. Broadleaf signalgrass was 6 inches in height, mexicanweed was at the 4-leaf stage and approximately 6 inches in height and soybeans were at the V5 (four fully expanded trifoliates) growth stage and 10 inches in height when the postemergence herbicides were applied. Two studies, a PE or PE followed by POT and POT only, were conducted. Weed control rating was made on August 8. A randomized complete block design with three replications was used. Ransom soybeans were planted on 30-in row spacings on June 25. Plot size was 10 x 25 ft (four 30-in rows) and the two inside rows were treated.

RESULTS AND DISCUSSION

Broadleaf signalgrass control was at least 85% for the Scepter PE (0.13 and 0.25 lb/A) and PE/POT sequential (0.13/0.13 lb/A), AC 263,499 PE (0.13 lb/A) and PE/POT sequential (0.06/0.06 lb/A), and Command PE treatments

(Table 13). Poor grass control was obtained with the other herbicide treatments. Mexicanweed control was poor (less than 40%) for all herbicide treatments. Both the dry conditions following PE application and the excessively large mexicanweed (6-in height) at the time of POT applications probably contributed to the poor mexicanweed control. Postemergence broadleaf signalgrass control using Scepter at 0.25 lb/A and AC 263,499 at 0.06 and 0.13 lb/A was 83, 93, and 95%, respectively (Table 14). Mexicanweed control with all the POT treatments was generally less than 85% reflecting the late time of application.

Table 13. Efficacy of several preemergence (PE) and postemergence overtop (POT) herbicides on broadleaf signalgrass and mexicanweed. T. Faulk Farm, Crowley, LA. 1985.

Treatment ^{1/}	Application method ^{2/}	Rate	Control	
			Broadleaf signalgrass	Mexicanweed
			7/29	7/29
		(lb ai/A)	------(%)-----	
Metribuzin	PE	0.38	49	13
Metribuzin + MZH 2091	PE	0.38 + 0.38	61	20
Canopy	PE	0.25	25	20
	PE	0.38	68	13
Canopy/Classic	PE/POT	0.38/0.008	64	25
DPX F6025	PE	0.047	44	18
	PE	0.063	23	10
DPX F6025/Classic	PE/POT	0.063/0.008	60	23
Scepter	PE	0.13	85	33
	PE	0.25	88	40
Scepter/Scepter	PE/POT	0.13/0.13	93	33
AC 263,499	PE	0.06	64	25
	PE	0.13	95	25
AC 263,499/AC 263,499	PE/POT	0.06/0.06	93	30
Lorox	PE	0.75	40	8
R 8259	PE	0.75	68	28
Command	PE	1.00	95	10
	PE	1.25	94	18
LSD (0.05)			28	16
CV (%)			29	52

^{1/} Nonionic surfactant (Ag 98) added at 0.25% (v/v) to Classic and AC 263,499 POT treatments.

^{2/} PE herbicides applied 6/25; POT herbicides applied 7/23.

Table 14. Efficacy of several postemergence overtop herbicides on broadleaf signalgrass and mexicanweed. T. Faulk Farm, Crowley, LA. 1985.

Treatment	Rate	Control	
		Broadleaf signalgrass 8/8	Mexicanweed 8/8
	(lb ai/A)	------(%)-----	
Blazer ^{1/}	0.50	30	72
Blazer + 2,4-DB ^{1/}	0.50 + 0.03	60	73
RH-0265	0.18	0	13
	0.25	7	7
RH-0265 + 2,4-DB	0.12 + 0.03	37	23
	0.18 + 0.03	13	27
Scepter	0.19	73	77
	0.25	83	80
Scepter + Blazer	0.13 + 0.19	60	68
Classic ^{1/}	0.008	20	20
	0.016	23	47
Classic + Blazer ^{1/}	0.008 + 0.19	70	50
Cobra ^{1/}	0.20	27	57
PPG 1013 ^{1/}	0.04	77	92
Reflex ^{1/}	0.25	27	42
	0.38	37	37
Blazer + Basagran ^{1/}	0.25 + 0.50	72	77
AC 263,499 ^{1/}	0.06	93	77
	0.13	95	83
LSD (0.05)		29	26
CV (%)		37	29

^{1/} Nonionic surfactant (Ag 98) added at 0.25% (v/v); all herbicide treatments applied 7/23.

MEXICANWEED RATE-TIMING TEST

MATERIALS AND METHODS

Ransom soybeans were planted on 30-in row spacings on June 25. Postemergence herbicides including Scepter, Classic, and Blazer were applied on June 11 and 23. All herbicide treatments were applied in 22 gal/A spray volume at 26 psi pressure. On the first application date (June 11), mexicanweed was at the cotyledonary to 3-leaf stage and approximately 2 inches in height and soybeans were at the V2 to V3 (one to two fully expanded trifoliates) growth stage and 3 to 4 inches in height. On the second application (June 23), mexicanweed was 4 to 6 inches in height and soybeans were at the V5 (four fully expanded trifoliates) growth stage and 10 inches in height. A 2 x 8 factorial arrangement in a randomized complete block design with four replications was used. Plot size was 7.5 x 25 ft (three 30-in rows) and two rows were treated.

RESULTS AND DISCUSSION

For the early application, mexicanweed control ratings were made on July 29 (18 DAT) and on August 8 (28 DAT). Control ratings were at least 90% and did not change over time where Scepter was applied at 0.13, 0.19, and 0.25 lb/A (Table 15). A significant drop in control 28 DAT, primarily reflected in both mexicanweed regrowth and new emergence, was noted for Classic at 0.008 lb/A and Blazer at 0.50 lb/A. Control ratings were made on August 8 (16 DAT) for the later application. Mexicanweed control where herbicides were applied late was significantly reduced as compared to ratings made on the same date for the early application for all herbicide treatments except Classic at 0.016 and Blazer at 0.50. The lower control was primarily reflected in weed regrowth. For the late application, mexicanweed control was more than 80% for only Scepter at 0.25 lb/A. Results indicate the importance of early application of herbicides on weed control as well as the cost savings associated with lower herbicide rates.

CONCLUSIONS

Preemergence applications of Scepter and Canopy, and PE/POT sequential applications of Scepter/Scepter and Canopy/Classic appear promising for control of morningglory, sicklepod, wild poinsettia, and mexicanweed. In several studies in 1985, unlike the previous year, dry conditions occurred after preemergence herbicide applications and activity, especially for Scepter, was severely reduced. In contrast, under similar conditions, Command gave excellent wild poinsettia control. Based on weed species evaluated postemergence, activity of Cobra and Reflex was similar to that of Blazer. Cobra, however, was more injurious and Reflex less injurious to soybeans. In general, soybean injury was minimal for all herbicide treatments evaluated in 1985.

Table 15. Efficacy of several postemergence overtop (POT) herbicides on mexicanweed when applied at two growth stages. T. Faulk Farm, Crowley, LA. 1985.

Treatment	Rate (lb ai/A)	Mexicanweed Control		
		Early ^{1/} application		Late ^{1/} application
		7/29	8/8	8/8
		-----%		
Scepter	0.13	93	91	76
	0.19	95	94	78
	0.25	94	95	83
Classic ^{2/}	0.008	89	76	39
	0.016	93	82	75
Blazer ^{2/}	0.38	93	84	53
	0.50	91	75	79
Check	----	0	0	0
LSD (0.05)		5	11	11

^{1/} Early application made on 7/11 when mexicanweed was 2 inches in height; late application made on 7/23 when mexicanweed was 4 to 6 inches in height.

^{2/} Nonionic surfactant (Ag 98) added at 0.25% (v/v).

GRAIN SORGHUM RESEARCH

(A Preliminary Report)

J.L. Griffin, D.E. Groth, R.J. Habetz, and R.P. Regan

INTRODUCTION

Grain sorghum [Sorghum bicolor (L.) Moench] acreage has increased in Louisiana in recent years. In the southwest area, grain sorghum may serve as an alternate crop to soybeans and may fit well into a rotation with rice. Since grain sorghum is not a host for *Rhizoctonia*, it may help reduce incidence of sheath blight in rice and aerial blight in soybeans.

GRAIN SORGHUM VARIETY TEST

MATERIALS AND METHODS

Fifty-four grain sorghum varieties were planted on a Crowley silt loam soil on April 22, 1985. Seeding rate was 6 seed/row ft. Fertilizer at a rate of 40-80-80 lb/A (N-P₂O₅-K₂O) was banded at planting and 75-0-0 lb/A (as ammonium sulfate) was broadcasted on May 13. Since not all varieties were safened against Dual or Lasso injury, only atrazine at 1.8 lb ai/A was surface applied after planting. The experimental area was cultivated twice. Plot size was four 32-in rows 30 ft in length. A randomized complete block design with three replications was used. Plots were combine harvested at maturity on August 7 and yields were adjusted to 13% moisture. Plant height was measured at maturity and Fusarium head mold ratings were made based on a scale of 0 = no head mold present and 9 = 100% of head infected.

RESULTS AND DISCUSSION

All varieties, with the exception of four, yielded at least 4000 lb/A (Table 1). Yields were 4800 lb/A or more for Opal (Asgrow), 1091 (Paymaster), PAG 6670 (Paymaster), and Two 80-D (Triumph). The top producing variety Opal produced 5102 lb/A. Mature plant height ranged from 36 inches for X31035 (Paymaster) to 48 inches for Savanna 5 (Northrup King). Fusarium head mold ratings made at maturity ranged from 1.0 (indicating light disease incidence) for Topaz, Two 70-D (Triumph), T-E Y-75 (Taylor-Evans), and Savanna 5 to 3.3 (light to moderate disease incidence) for Penngrain YE (Penngrain) and X31035. This is the first year that grain sorghum varieties have been evaluated. Future research should provide a more representative estimate of yield potential under south Louisiana conditions.

Table 1. Performance of commercial grain sorghum varieties grown on a Crowley silt loam soil at the Rice Research Station, Crowley, LA. 1985.

Company or brand	Hybrid	Yield	Plant height at maturity	Fusarium head mold rating ^{1/}
		-(lb/A)-	---(in)----	
Asgrow	Opal	5102	43	1.3
Paymaster	1091	4840	46	1.3
Paymaster	PAG 6670	4807	45	1.7
Triumph	Two 80-D	4799	43	1.7
Asgrow	H 8204	4770	44	1.7
Coker	7638	4763	38	2.0
Taylor-Evans	T-E Dinero	4747	41	2.0
Paymaster	PAG 5665	4724	39	1.7
Pioneer	8222	4694	42	1.3
Paymaster	1022	4681	42	2.3
Funk's	1711	4649	44	2.0
Terral-Norris	Sunbelt 444	4627	41	2.3
Paymaster	R 1090	4620	42	2.3
Stauffer	9736	4608	42	1.3
Paymaster	PAG 4462	4596	44	1.3
Pioneer	8300	4571	41	2.0
Paymaster	PAG 5572	4522	43	1.3
Penngrain	Penngrain DR	4518	41	1.7
Dekalb-Pfizer	M-565	4510	42	1.7
Northrup King	2665	4499	43	1.7
Pioneer	8333	4465	39	2.0
Terra Seed Company	HT 126 DR	4434	41	2.0
Arkansas County Seed	Ro-Jo	4430	44	3.0
Asgrow	O.S Gold GS712	4425	39	2.3
Seed Tec. Int.	WAC 715 DR	4421	46	2.0
Penngrain	Penngrain YE	4420	39	3.3
Asgrow	Topaz	4411	43	1.0
Asgrow	Chaparal	4403	43	1.3
Paymaster	DR 1125	4388	42	1.7
Funk's	G522 DR	4375	40	2.0
Seed Tec. Int.	WAC 710 DR	4372	41	1.7
Dekalb-Pfizer	DK-64	4348	43	2.0
Stauffer	9750	4319	44	1.7
McCurdy	84-74	4315	44	1.7
Triumph	Two 70-D	4298	43	1.0
Taylor-Evans	T-E Y-75	4297	46	1.0
Northrup-King	2656	4292	43	2.0
Hyperformer	1330 DR	4237	46	2.7
Seed Tec. Int.	WAC D 701G	4196	42	1.3
Warner	W-876 DR	4195	43	1.7
McCurdy	M57YG	4154	44	2.0
Northrup King	Savanna 5	4154	48	1.0
Terra Seed Company	HT 128G DR	4135	41	2.7
Taylor-Evans	T-E Dinero-E	4134	38	2.7

CONTINUED.

Table 1. (Continued).

Company or brand	Hybrid	Yield	Plant height at maturity	Fusarium head mold rating ^{1/}
		-(lb/A)-	---(in)----	
Coker	7675	4131	40	1.3
Northrup King	2660	4114	40	2.0
Paymaster	PAG 6658	4098	45	1.7
Stauffer	530GR	4079	38	2.3
Warner	W-839 DR	4056	39	2.0
Hyperformer	1225 DR	4051	44	2.3
Funk's	HW 6045	3888	42	1.7
Stauffer	9533	3700	40	2.7
Paymaster	X31035	3600	36	3.3
Warner	W-851 DR	3564	38	3.0
Mean		4380	42	1.9
C.V.(%)		9.9	7.1	35.9
LSD (0.05)		700	2	1.1

^{1/} Rated on a scale of 0 to 9 with 1 = no disease and 9 = 100% of head infected.

GRAIN SORGHUM SEED SAFENER TEST

MATERIALS AND METHODS

Two grain sorghum varieties R 1091 and Terra 126 DR were treated with both Concep (Ciba Geigy Corporation) and Screen (Monsanto Agricultural Products Company) seed safeners. Seed were planted at a rate of 6 seed/row ft on May 30, 1985. Fertilizer at a rate of 40-80-80 lb/A ($N-P_{25}-K_{20}$) was banded at planting and 75-0-0 lb/A (as ammonium sulfate) was broadcasted on June 1. Dual (Ciba Geigy Corporation) at 2.0 lb/A plus atrazine at 1.5 lb/A and Lasso MT (Monsanto Agricultural Products) at 2.5 lb/A plus atrazine at 1.5 lb/A were surface applied following planting of R 1091 and Terra 126 DR grain sorghum treated with both Concep and Screen. For comparison, R 1091 treated with both Concep and Screen followed by a preemergence treatment of Prowl at 1.0 lb/A plus atrazine at 1.5 lb/A was included. Herbicide treatments were applied in 26 gal/A spray volume at 26 psi pressure. The experimental area was cultivated twice. Plot size was four 32-in rows 30 ft in length. Grain sorghum plant population was determined on June 4 by counting the number of plants from two areas 3 ft in length from the center two rows of each plot. Plots were combine harvested at maturity on August 7 and yields were adjusted to 13% moisture. A randomized complete block design with four replications was used.

RESULTS AND DISCUSSION

At present, labels for Concep and Screen seed safeners state that Dual be used only with Concep treated seed and Lasso MT be used only with Screen treated seed. This study was conducted to not only compare grain sorghum response to the labeled treatments but to also evaluate grain sorghum response to Dual used with Screen safened seed and Lasso MT used with Concep safened

seed. Both R 1091 and Terra 126 DR grain sorghum stands were similar for Concep safened seed with either Dual or Lasso MT and Screen safened seed with either Dual or Lasso MT (Table 2). Plant stand counts of both varieties, however, were higher where Lasso MT was applied following seed treated with Concep than seed treated with Screen. Stand counts where Dual was applied were similar regardless of the safener used. R 1091 grain sorghum yields were similar where Dual or Lasso MT followed seed safened with either Concep or Screen. In contrast, Terra 126 DR yields were higher where Dual followed Concep safened seed than where Dual followed Screen safened seed. Yields for Terra 126 DR, however, were similar where Lasso MT followed Concep and Screen safened seed. Where labeled combinations were used (Dual with Concep and Lasso MT with Screen), R 1091 sorghum yields were similar but Terra 126 DR yields were higher for the Dual with Concep as compared to Lasso MT with Screen. R 1091 yields where Prowl was applied at 1.0 lb/A were lower than the Dual with Concep treatment but similar to the Lasso MT with Screen. It appears, based on this study, that use of either Dual or Lasso with Concep or Screen safened seed, even though not labeled, should not result in reduced grain sorghum stands or yields.

Table 2. Influence grain sorghum seed safeners and herbicide treatments on plant stand and yield. Rice Research Station, Crowley, LA. 1985.

Cultivar	Seed safener	Herbicide rate	Plants/ 3 ft row	Yield
		------(lb/A)-----	--(no.)--	(lb/A)
R 1091	Concep	Dual 2.0 + atrazine 1.5	11.3	3438
	Concep	Lasso MT 2.5 + atrazine 1.5	13.0	2641
	Screen	Dual 2.0 + atrazine 1.5	11.3	2906
	Screen	Lasso MT 2.5 + atrazine 1.5	10.0	2997
Terra 126 DR	Concep	Dual 2.0 + atrazine 1.5	10.9	3236
	Concep	Lasso MT 2.5 + atrazine 1.5	12.6	2705
	Screen	Dual 2.0 + atrazine 1.5	10.1	2520
	Screen	Lasso MT 2.5 + atrazine 1.5	10.6	2559
R 1091	-----	Prowl 1.0 + atrazine 1.5	10.3	2417
LSD (0.05)			1.7	597

GRAIN SORGHUM WEED CONTROL TEST

MATERIALS AND METHODS

R 1090 grain sorghum was planted on May 20, 1985 at 6 lb/A. Fertilizer at a rate of 40-80-80 lb/A ($\text{N-P}_{205}\text{-K}_{20}$) was banded at planting and 75-0-0 lb/A (as ammonium sulfate) was broadcasted on June 1. Preemergence herbicides (PE) Dual, Lasso MT, Prowl, atrazine, and Racer were surface applied after planting on June 1. Postemergence herbicides were applied overtop (POT) on May 20 when barnyardgrass was 1 to 2 inches in height, morningglory (mostly pitted) and cocklebur were 2 inches in height, and grain sorghum was 6 to 8 inches in height. All herbicides were applied in 22 gal/A spray volume at 26 psi pressure. Weed control and grain sorghum injury ratings were made on June 4 (15 days after postemergence treatment). Plot size was 10 x 25 ft (four 30-in rows) with the inside 6 ft (two rows) treated. A randomized complete block design with four replications was used.

RESULTS AND DISCUSSION

Barnyardgrass control was excellent for all herbicide treatments (Table 3). Morningglory control was excellent for all treatments except Lasso MT followed by Bucril at 0.25 and 0.38 lb/A which provided only 75% control and for Racer applied PE at 0.50 and 0.75 lb/A which gave poor control. With the exception of Racer, cocklebur control was at least 84% for all treatments. Addition of atrazine at 1.25 lb/A to Racer increased both morningglory and cocklebur control to approximately 99%. Lower cocklebur control was observed where Lasso MT was followed by either 2,4-D or Bucril as compared to Lasso MT plus atrazine or Lasso MT followed by atrazine. Grain sorghum injury was severe (25% or more) for Lasso MT plus atrazine followed by atrazine, Lasso MT plus atrazine followed by 2,4-D, and Racer plus atrazine. Injury was primarily manifested as stunting. Bleaching of sorghum leaves was noted where Racer was applied PE at 0.75 lb/A. Even though injury varied somewhat, grain sorghum yields were similar regardless of herbicide treatment used and averaged 3890 lb/A.

The purpose of this study was to compare several herbicide treatments to the standard practice of using either Dual or Lasso plus atrazine at planting. Producers would not have the option of planting soybeans after atrazine application due to severe injury problems. Where a producer would prefer not to use atrazine until a grain sorghum stand is assured, the atrazine POT following a Dual or Lasso PE would provide comparable weed control to the PE tank mix of either Dual or Lasso plus atrazine. Bucril may be used as a 2,4-D substitute where cocklebur is a problem but may be less effective than 2,4-D on pitted morningglory. In these studies, it is evident that Dual, Prowl, or Lasso MT plus atrazine or Lasso followed by atrazine provide comparable and excellent control of barnyardgrass, morningglory, and cocklebur with minimal grain sorghum injury.

Table 3. Efficacy of several preemergence (PE) and postemergence over-the-top (POT) herbicides on weed control in grain sorghum. Rice Research Station, Crowley, LA. 1985.

Herbicide ^{2/}	Application method	Rate (lb ai/A)	Control ^{1/}			Grain sorghum injury	Yield (lb/A)
			Barnyard-grass	Morning-glory	Cocklebur		
Dual + atrazine	PE	1.50 + 1.60	100	100	100	16	3817
Prowl + atrazine	PE	1.00 + 1.60	100	100	100	19	3323
Lasso MT + atrazine	PE	2.00 + 1.60	100	99	100	10	3868
Lasso MT/atrazine	PE/POT	2.00/1.60	100	100	98	6	4533
Lasso MT/2,4-D	PE/POT	2.00/0.50	99	93	86	8	2953
Lasso MT/Buctril	PE/POT	2.00/0.25	100	78	89	4	3997
	PE/POT	2.00/0.38	100	75	84	1	4035
Lasso MT + atrazine/atrazine	PE/POT	2.00 + 1.60/1.20	100	100	100	25	4177
Lasso MT + atrazine/2,4-D	PE/POT	2.00 + 1.60/0.50	100	99	98	35	4409
Lasso MT + atrazine/Buctril	PE/POT	2.00 + 1.60/0.25	100	100	100	11	4300
	PE/POT	2.00 + 1.60/0.38	100	99	99	23	4173
Racer	PE	0.50	100	38	41	3	3077
	PE	0.75	100	48	65	16	3121
Racer + atrazine	PE	0.50 + 1.25	100	99	98	35	4666
LSD (0.05)			NS	14	6	17	NS

^{1/} Control and injury ratings made on 6/4.

^{2/} PE herbicides applied 5/1; POT herbicides applied 5/20.

CORN VARIETY TRIAL

(A Progress Report)

J.L. Griffin, R.J. Habetz, and R.P. Regan

INTRODUCTION

Corn acreage has increased in Louisiana in recent years. Since producers in southwest Louisiana are looking for alternative crops, field corn varieties were evaluated for yield performance at the Rice Research Station.

MATERIALS AND METHODS

An early variety 'Pioneer 3369A', two midseason varieties, 'Pioneer 3165' and 'Ring Around 1604', and one late season variety 'Paymaster 8990' were planted on April 4 at a planting rate of 1 seed/7 inches of row to obtain a harvest population of 24,000 plants/acre. A 32-in row spacing was used and fertilizer was banded at planting at a rate of 40-80-80 lb/A ($N-P_{2O_5}-K_2O$). Corn was topdressed with urea at a rate of 150 lb N/A when it reached a 6-in height. Dual at 2.0 lb/A plus atrazine at 1.2 lb/A were applied to the experimental area after planting. Plots were cultivated twice. Due to extremely dry conditions, the experimental area was flood irrigated on June 1. A randomized complete block design with four replications was used. Plot size was four rows 30 ft in length. At maturity, the two center rows from each plot four were hand harvested and shelled. Yields were adjusted to 15% moisture.

RESULTS AND DISCUSSION

Corn yields ranged from 54.4 bu/A for Ring Around 1604 to 89.9 bu/A for Pioneer 3369A (Table 1). At these yield levels, production of corn, especially under irrigation, would not be economical at present market conditions. Severe stink bug and corn ear worm infestations occurred.

Table 1. Performance of several field corn varieties grown on a Crowley silt loam soil at the Rice Research Station, Crowley, LA. 1985.

Variety	Yield (bu/A)	Tassel date
Pioneer 3369A	89.9	5/26
Paymaster 8990	89.0	5/30
Pioneer 3165	82.3	6/9
Ring Around 1604	54.4	6/7
LSD (0.05)	12.1	---
C.V. (%)	9.6	---

WHEAT VARIETY TEST

(A Progress Report)

J.L. Griffin, R.J. Habetz, and R.P. Regan

INTRODUCTION

Wheat acreage in Louisiana has fluctuated in recent years. Most farmers who grow wheat plan to double-crop with soybeans. Wheat varieties are presently available which are more tolerant to rust, septoria glume blotch, and powdery mildew. Earlier maturing varieties have also been released which make double cropping more attractive. Studies were initiated to test performance of wheat varieties in the rice area of southwest Louisiana.

MATERIALS AND METHODS

Twenty-seven wheat varieties were drill seeded (90 lb/A) in 7-in rows on December 17, 1984. Fertilizer at a rate of 30-92-92 lb/A ($\text{N-P}_{20}^5\text{-K}_{20}$) was incorporated in early November. Since excessive rainfall delayed planting, nitrogen was topdressed at 25-0-0 lb/A on December 18. An additional application of 55-0-0 lb/A was made on February 15. A randomized complete block design with four replications was used. Plots were combine-harvested on May 10 and yields were adjusted to 13% moisture. Date of 100% head emergence and mature plant height were determined for all varieties.

RESULTS AND DISCUSSION

Considering the late planting date, wheat yields in 1985 were excellent. Yields ranged from 86.3 bu/A for 'Probrand 812' to 25.2 bu/A for 'Pioneer 2550' (Table 1). Twelve varieties yielded 70 or more bu/A: Probrand 812, 'Coker 797', 'Terral 817', 'Florida 302', 'Terral 812', 'HW 3015', 'McNair 1003', '78 DW 14', 'Coker 916', 'Hunter', 'Rosen', and 'Florida 301'. Three-year average yields of Coker 797, 'Coker 762', and Terral 812 were greater than 65 bu/A. All varieties headed in April, with Coker 797 the earliest (April 1) and 'Caldwell' and Pioneer 2550 the latest (April 23). Mature plant height was at least 30 inches for all varieties except Coker 762, Hunter, 'Coker 983', and Probrand 812. Florida 302 was the tallest variety with a 37-in plant height. Lodging was minimal for all varieties.

Table 1. Performance of wheat varieties grown on a Crowley silt loam soil.
Rice Research Station, Crowley, LA. 1983-1985.^{1/}

Variety	Yield (bu/A) ^{2/}				Heading ^{3/} date	Mature ^{3/} plant ht (in)
	1985	1984	1983	3-year average		
Coker 797	82.6	74.5	47.6	68.2	4/1	33
Coker 762	66.5	80.9	51.3	66.2	4/7	29
Terral 812	77.9	77.2	42.0	65.7	4/5	31
McNair 1003	76.1	72.4	40.4	63.0	4/10	33
Hunter	72.5	76.5	37.3	62.1	4/2	27
Rosen	72.2	75.0	38.2	61.8	4/4	31
Florida 301	72.2	69.5	39.4	60.4	4/3	38
Terral 817	80.0	65.6	33.2	59.6	4/5	30
Southern Belle	66.6	72.7	33.9	57.7	4/13	30
Coker 916	73.9	56.3	33.5	54.6	4/10	34
Coker 747	63.6	61.2	33.1	52.6	4/13	30
Omega 78	65.4	64.6	27.5	52.5	4/5	31
Nelson	55.5	59.2	28.7	47.8	4/15	32
Delta Queen	--	66.6	41.3	--	--	--
Florida 302	80.0	79.0	--	--	4/13	37
Coker 983	67.3	80.2	--	--	4/5	29
Probrand 812	86.3	--	--	--	4/5	29
HW 3015	76.8	--	--	--	4/13	32
78 DW14	74.6	--	--	--	4/10	34
HW 3022	67.5	--	--	--	4/17	32
Texred	61.8	--	--	--	4/5	30
Magnum	61.7	--	--	--	4/13	32
HW 3021	60.9	--	--	--	4/13	34
Massey	55.5	--	--	--	4/6	34
Saluda	55.5	--	--	--	4/15	30
G 84	55.3	--	--	--	4/17	32
Caldwell	27.6	--	--	--	4/23	31
Pioneer 2550	25.2	--	--	--	4/23	30

^{1/} Planted 12/17/84; fertilization 30-90-90 at planting and 80-0-0 topdress.

^{2/} Yields adjusted to 13% moisture.

^{3/} 1985 data.

AQUACULTURE RESEARCH

COMPARISON OF RICE VARIETIES FOR CRAWFISH FORAGE

(A Progress Report)

M.W. Brunson, C.R. Weirich, and S.M. Simon

INTRODUCTION

Perhaps the most efficient and dependable method of providing vegetation for crawfish (Procambarus spp.) forage is through the use of a cultivated crop. Use of such a crop species has a number of advantages. The farmer can control the type of forage which will be available and is not dependent upon volunteer vegetation. A good stand of vegetation is assured, and the concern over severe weed problems in subsequent years due to unchecked natural vegetation is minimized. In many cases, the farmer can realize a cash crop from the forage plants in addition to supplying fodder for crawfish.

Several agronomic plants have been used and evaluated as crawfish forage. Among these are rice (Oryza sativa), Japanese millet (Echinochloa frumentacea), sugarcane (Saccharum officinarum), and soybean (Glycine max). By far the most promising is rice. Crawfish have been harvested incidentally from rice fields for decades and rice has been shown to be superior to other planted forages as well as natural vegetation for crawfish production (Chien and Avault 1980; Miltner and Avault 1981). With approximately 463,000 acres of rice in Louisiana, the potential for integrating rice and crawfish productions is great. The general timings of rice and crawfish productions coincide conveniently, and because rice is a semi-aquatic plant, it tends to persist longer under a winter flood than other agronomic crop species.

Previous studies evaluating rice as a planted crawfish forage have utilized the varieties Labelle and, to a lesser extent, Saturn. Taylor et al. (1983) and Brunson et al. (1984), have data revealing a considerable range in biomass production among rice varieties, and that Saturn ranks among the lowest of 25 rice varieties tested for forage quality characteristics.

This study is being conducted to (1) continue rice evaluations for crawfish forage and (2) determine the relationships between various quantitative and qualitative forage parameters and crawfish production.

MATERIALS AND METHODS

Six of the 11 rice varieties evaluated in 1984 (Brunson et al.) were drill seeded in a prepared seedbed (7-in row spacings) at the rate of 90 lb/A on May 30, 1985. Fertilizer (462 lb/A 13-13-13) was broadcast prior to planting. To encourage germination, rice was flushed after planting. Propanil was aerially applied at 4 lb ai/A and 200 lb/A fertilizer (21-0-0) was applied on July 1. A

shallow permanent flood was established on July 2 and maintained until grain maturity.

Experimental plots measured 95 x 90 ft (0.20 A) with 5-ft levees between plots. Plots were filled and drained independently of other plots from a common water delivery lateral. Experimental design was a randomized complete block with four replications per treatment.

At grain maturity, an area of 25 ft² was harvested leaving 1- to 2-in stubble in order to determine straw and total biomass yield. Grain was combine harvested from 500 ft² and yield was adjusted to 12% moisture. Following grain maturity sampling, all plots were combine harvested to remove grain, leaving as much stubble height as possible. Stubble was flushed to encourage ratoon growth and a permanent fall flood was applied on November 1, 1985. At flood-up, all plots were again sampled by removing 2.5 ft² of area and stubble, ratoon, and grain components were separated and quantified. At subsequent 6-wk intervals, plots were sampled to determine total biomass present. Subsamples from all vegetative samples were dried in a forced air drier at 150°F until a constant weight was attained.

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 variety. Plant height and lodging (lodging rating 0-9; 0 = no lodging, 1 = 1-10% . . . 9 = >81% lodged) were recorded at grain maturity. Ratoon ratings (0-9; 0 = no mature culms producing ratoons, 1 = 1-10% . . . 9 = >81% of mature culms producing ratoons) were taken at fall flood-up. Degree of plant senescence (0-9; 0 = no stem or leaf senescence, 1 = 1-10% . . . 9 = >81% stem or leaf senescence) was rated at grain harvest, flood-up, and at subsequent 6-wk intervals.

RESULTS AND DISCUSSION

Stand ratings taken 2 and 5 wk postseeding revealed poor to moderately good stand densities for all varieties (Table 1). The low initial stand densities resulted from an extended period (10 days) between drill seeding and the first flushing. This delay was due to levee construction which temporarily prevented irrigation. Seed germination was not uniform and stand qualities suffered, but after 5 wk all varieties exhibited adequate stands.

Days to 50% heading ranged from 72 to 86 (Labelle and Starbonnet, respectively) and averaged 78.4 days. Plant height at grain maturity ranged from 32 to 48 inches (Lemont and Saturn, respectively) and averaged 40.6 inches (Table 2).

Grain yields (Table 2) ranged from 3748 lb/A (Labelle) to 4967 lb/A (Mars) and averaged 4345 lb/A. With the exception of Labelle, all varieties yielded of least 4000 lb/A of grain.

Straw dry matter (DM) yields at grain harvest ranged from 3091 lb/A (Labelle) to 5681 lb/A (Starbonnet) and averaged 4385 lb/A (Table 2).

Lodging at grain maturity was significant only for Saturn (rating = 8.0; Table 1). Little or no lodging occurred in the other five varieties. Grain harvesting efficiency was affected by lodging only in the Saturn plots.

Table 1. Stand, lodging, senescence, and ratoon ratings for six double-cropped rice varieties evaluated as cultivated forage for crawfish.
Rice Research Station, Crowley, LA. 1985.

Variety	Stand rating ^{1/}		Lodging ^{2/} 6-Wk postflood	Plant senescence ^{3/}		Ratoon at flood-up
	2-Wk	5-Wk		Grain maturity	6-Wk postflood	
Labelle	3.5	7.8	9	3.1	9	5.3
Lemont	3.0	7.0	9	4.0	9	7.5
Mars	4.0	8.3	9	3.1	9	7.3
Saturn	4.0	7.3	9	8.6	9	1.3
Starbonnet	6.0	7.8	9	4.7	9	3.3
Nortai	3.0	7.5	9	2.6	9	7.5
Mean	3.9	7.6	9	4.4	9	5.3
C.V.	56.5	12.4	0	50.1	0	25.0
LSD (0.05)	NS	NS	0	1.96	0	1.9

^{1/} Stand rating: 1-10; 1 = no stand, 10 = ideal stand.

^{2/} Lodging rating: 1-10, 0 = no lodging, 1 = 1-10%, 2 = 10-20 % . . . 9 = >81% lodged.

^{3/} Senescence rating: 0 = no stem or leaf senescence, 1 = 1-10%, 2 = 11-20% . . . 9 = >81% leaf or stem senescence.

Table 2. Planting to grain maturity data on parameters affecting the yield and suitability of six double-cropped rice varieties as cultivated forage for crawfish production. Rice Research Station, Crowley, LA. 1985.

Variety	Days to 50% heading	Hgt. at grain maturity (in)	Days to grain harvest	Grain yield at 12% H ₂ O (lb/A)	Straw yield lb. DM/A
Labelle	72	41	120	3748	3091
Lemont	78	32	120	4513	4714
Mars	76	39	120	4967	4796
Saturn	80	48	120	4496	3983
Starbonnet	86	44	120	4271	5681
Nortai	78	40	120	4074	4047
Mean	78.4	40.6	120	4345	4385
C.V.	0.63	2.2	0	11.8	20.2
LSD (0.05)	0.69	1.25	-	707	625

Senescence at grain harvest was significantly ($P < 0.05$) higher for Saturn (8.6) than for other varieties. Lemont (4.0) and Starbonnet (4.7) were the only other varieties with senescence greater than 4.0 at grain harvest. All varieties were senesced by 6-wk postflood (Table 1).

Ratoon response ranged from 309 lb/A (Starbonnet) to 2454 lb/A (Labelle) and averaged 1150 lb/A (Table 3). Ratoon production by Labelle was nearly three times that of any variety except Nortai (1852 lb/A). Ratoon production was likely affected by the late date of harvest (October 10) resulting from a May 30 planting date.

Biomass persistence, as indicated by amount of biomass present at 6-wk postflood intervals, is an important crawfish forage parameter (Table 3). Total DM (stubble + ratoon) present at flood-up ranged from 1207 lb/A (Saturn) to 2577 lb/A (Starbonnet), averaging 1890 lb/A. Because the grain was harvested in early October, the full ratoon response was not realized until after the November flood. Consequently, biomass increased significantly during the first 6-wk postflood. Dry matter biomass 6-wk postflood ranged from 999 lb/A (Saturn) to 4734 lb/A (Nortai) and averaged 2622 lb/A. Significant differences in ratoon response were noted (Table 3). From 6 to 18 wk postflood, DM biomass decreased for all varieties. After 18-wk, DM ranged from 338 lb/A (Starbonnet) to 1329 lb/A (Nortai) and averaged 619 lb/A (Table 3).

Biomass production in 1985 by these six rice varieties was substantially lower than that attained in 1984 (Brunson et al. 1984). As has been previously mentioned, this is due to a later planting date and lower quality stands in 1985 as compared to 1984. Even with these differences, the trends in biomass persistence among the varieties remained essentially the same. By far the most outstanding of the varieties evaluated is Nortai. Its qualities of biomass production combined with its superior persistence rank it far above the remaining varieties from a forage production standpoint. However, yet to be determined is the correlation of crawfish production with those forage parameters. Studies are in progress to determine if a variety such as Nortai, with obvious "on paper" advantages will indeed provide the necessary factors which will result in increased crawfish production.

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Table 3. Post grain-harvest data on parameters affecting suitability of six doubled-cropped rice varieties as cultivated forage for crawfish production. Rice Research Station, Crowley, LA. 1985.

Variety	Biomass at flood-up ^{1/} Stubble	Total postflood biomass			
		6 Wk stubble	6 Wk ratoon	12 Wk	18 Wk
Labelle	1990	614	2454	883	500
Lemont	1697	1350	465	1092	518
Mars	2250	1617	943	1051	671
Saturn	1207	118	881	1072	356
Starbonnet	2577	2250	309	775	338
Nortai	1618	2883	1852	1665	1329
Mean	1890	1472	1150	1090	619
C.V.	32.5	40.1	61.1	35.5	21.2
LSD (0.05)	NS	817	975	53.5	182

^{1/} Biomass reported as lb DM/A.

EVALUATION OF THREE SORGHUM TYPES AS CULTIVATED FORAGE FOR CRAWFISH PRODUCTION

(A Progress Report)

M.W. Brunson, C.R. Weirich, and S.M. Simon

INTRODUCTION

Most intensively cultured aquatic species are fed a commercially prepared, balanced diet feed which is delivered to the animals on a daily basis. Commercially cultured crawfish (Procambarus spp.), however, subsist by foraging on various components of the vegetative detrital system in ponds containing an abundance of natural vegetation. Although commercially prepared feeds have been shown to produce excellent growth and crawfish production (Smitherman et al. 1967; de la Bretonne et al. 1969; Huner et al. 1974; Cange et al. 1982), the economic feasibility of such a feed delivery strategy remains in question. At present, the use of standing vegetation appears to be the more economical and efficient feeding system for crawfish production.

Native plant species such as alligatorweed (Alternanthera philoxeroides), water primrose (Jussiaea spp.), and smartweed (Persicaria spp.) have traditionally been utilized as forage for crawfish production. A major disadvantage to these wild plants is that they are considered weed species in agricultural areas. A large portion of Louisiana's 120,000 acres of pond-raised crawfish is agricultural land where crawfish are considered an alternate or rotational crop. Thus, plant species which pose no weed threats are desirable as crawfish forage. Utilization of an agronomic species offers a potential for double-cropping with crawfish. Cultivated forage crops provide a more dependable and predictable food supply than do volunteer weed species. Additionally, with planted crops the farmer has control over vegetation type and can choose the crop species which integrate most efficiently with his other agricultural practices.

Of the agronomic crops which have been tested, rice (Oryza sativa) has proven to be the most efficient cultivated forage for crawfish (Chien and Avault 1980; Miltner and Avault 1981). Other crops which have been evaluated are soybean (Glycine max), sugarcane (Saccharum officinarum) and millet (Echinochloa spp). The identification of crops which can be economically planted and cultivated and would supply adequate forage for crawfish production can provide farmers with alternatives for developing cropping systems tailored to individual farm needs and situations.

One agronomic crop which is gaining popularity in Louisiana is grain sorghum (Sorghum bicolor). The 180,000 acres planted to grain sorghum in 1983 was more than twice that grown in 1981. Total production statewide in 1983 was 5.6 million hundredweight, valued at \$28.1 million (LCES 1982; 1983). The increasing grain sorghum acreage has kindled interest in potential use of this crop as a crawfish forage. This study was initiated to address this interest and to evaluate the potential of grain sorghum and two other types of sorghum

(forage and sorghum-sudangrass hybrid) as cultivated forage for crawfish in both double-cropping and crawfish monoculture systems. In the double-crop system, both crops would be managed as cash crops, and sorghum ratoon growth used as forage for crawfish. In the crawfish monoculture system, sorghum would be planted solely to provide forage for crawfish production, and would probably be planted in mid- to late summer.

MATERIALS AND METHODS

Three sorghum types were evaluated. Sorghum varieties used were: Paymaster R1090 grain sorghum, Funk's FP-4 sorghum-sudangrass hybrid and Funk's 102F forage sorghum. Planting date was June 23. Experimental design was a randomized complete block with four treatment replications. The three sorghums were drill seeded in 140 ft² plots at the following rates: Grain sorghum - 6 lb/A; forage sorghum - 23 lb/A; sorghum sudangrass - 23 lb/A. No fertilizer or pesticides were applied during the study. Stand ratings based on an arbitrary scale of 1 to 10 (10 = ideal stand) were taken 2 and 5 wk post-seeding for both planting dates. On August 22 all forage sorghum and sorghum-sudangrass plots were harvested and hay dry matter production determined. Vegetation was clipped to a 4-in stubble using a Carter flail-type harvester. Regrowth ratings were taken 2 and 5 wk postharvest. Grain sorghum was harvested from each plot at grain maturity.

Forage production for all sorghum types was estimated on November 4 by hand clipping all biomass from 12.5 ft² of each plot. Prior to sampling, all plots were flooded to simulate fall flooding for crawfish, and the flood was maintained through the winter. At subsequent 6-wk intervals sampling was conducted to determine biomass persistence and quality.

RESULTS AND DISCUSSION

Stand ratings taken 2 and 5 wk post-seeding indicated good to excellent stand densities for all sorghums. Straw dry matter (DM) yield for hay from the sorghum-sudangrass hybrid was not significantly different ($P < 0.05$) than that from forage sorghum. Regrowth ratings 2 and 5 wk postharvest were good for both sorghum types, and ratoon DM yields at pond flood-up were similar for these two sorghums. Grain sorghum DM present at flood-up was similar to the other two sorghums (Table 1).

From a crawfish forage standpoint, important considerations include not only the quantity of forage present, but also the persistence and quality of that forage. Postflood sampling quantified the rates of disappearance among the three sorghums. No significant ($P > 0.05$) differences in DM biomass were detected among the sorghums at flood-up. However, after 6 wk under flood, the grain sorghum retained significantly greater ($P < 0.05$) DM biomass than the forage sorghum or sorghum-sudangrass. Between 6 and 12 wk postflood, the rate of disappearance for the grain sorghum was more rapid than for the other two sorghums, and by the end of 12 wk again no differences in DM biomass existed. By 18 wk postflood forage sorghum and sorghum-sudangrass retained greater ($P < 0.05$) DM biomass than did the grain sorghum (Table 2). In general, the rate of decomposition and loss of grain sorghum dry matter through the winter was more rapid than for the other two sorghums.

Table 1. Seeding to crawfish pond flood-up data on parameters affecting the suitability of three types of sorghum as crawfish forage, Rice Research Station, Crowley, LA. 1985.

Variety/ type	Planting date	Biomass ^{2/} at grain maturity		Stand rating ^{1/} 2 Wk	1/ 5 Wk	Straw/ hay		Grain yield @ 12% H ₂ O	Regrowth ^{3/}		Biomass at flood-up Straw & ratoon	Total biomass production to flood-up
		2 Wk	7.0	7.8	5 Wk	2317	N/A	2 Wk	5 Wk	5 Wk		
102F Forage sorghum	6/23	7.0	7.8	7.8		2317	N/A	5.0	6.8		1687	3991
R1090 Grain sorghum	6/23	8.0	8.0	8.0		N/A	3228	N/A	N/A		1897	5125
FP4 Sorghum- sudan	6/23	7.3	7.8	7.8		4943	N/A	7.0	9.0		1729	6672
LSD (.05)		NS	NS	NS		NS	--	1.1	1.2		NS	1800

^{1/} Stand rating (0 to 10), 10 = ideal stand.

^{2/} Biomass expressed as lb DM/A.

^{3/} Regrowth rating (0 to 10), 10 = vigorous, dense regrowth.

Table 2. Postflood data on biomass parameters affecting the suitability of three types of sorghum as cultivated forage for crawfish, Rice Research Station, Crowley, LA. 1985.

Variety	Planting date	Total biomass present at flood-up	Total postflood biomass		
			6 Wk	12 Wk	18 Wk
102F			-----1b DM/A-----		
Forage sorghum	6/23	1686	631 b	529	395
R-1090					
Grain sorghum	6/23	1897	1336 a	308	137
FP4					
Sorghum-sudangrass	6/23	1729	790 b	530	365
LSD (.05)		NS	539	NS	160
Mean		1771	919	455	299

Total season-long biomass production was greatest for the sorghum-sudangrass, which yielded 4,943 lb/A hay and 1,729 lb/A regrowth before the fall flood (Table 1). The grain sorghum yielded 3,228 lb/A grain and regrowth totaled 1,897 lb/A resulting in total DM yield over 5,000 lb/A. Both these sorghums possess characteristics which may lend them to use in a crawfish/sorghum double-cropping system. In such systems, grain or hay, depending upon variety utilized, could represent a cash crop, while the stubble and ratoon growth could provide forage for crawfish production. Additionally, hay harvested from the sorghum-sudangrass could be used to supplement food supplies in crawfish ponds where vegetation has been depleted.

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COMPARISON OF SEVEN TERRESTRIAL VEGETATIVE TYPES FOR CRAWFISH FORAGE

(A Preliminary Report)

M.W. Brunson, C.R. Weirich, and S.M. Simon

INTRODUCTION

Establishment and maintenance of adequate vegetative forage is a major challenge to crawfish farmers. Numerous plant types have been utilized as crawfish forage (Avault et al. 1983) and these can be categorized into two groups; volunteer natural vegetation and cultivated plants. Of all the previously evaluated plants, rice (Oryza sativa) has proven to be the superior crawfish forage. Because of previous research findings and observations, rice is currently the most commonly recommended plant for crawfish ponds.

Not all ponds are suitable for establishing rice, however, and in some cases the farmer may prefer an alternative to planting rice for his crawfish. The actual number of alternative crawfish forages previously screened is relatively small, and many potentially useful plants have yet to be evaluated. The objective of this study was to compare seven terrestrial vegetative types which may have potential as alternative forages in a crawfish production system.

MATERIALS AND METHODS

Seven terrestrial vegetative types were drill seeded into 8-in rows with a seven row Kincaid cone-planter on July 20, 1985. Plot size was 4.7 x 30 ft, and the study was arranged in a randomized complete block design with four replications. Seeding rates were: browntop (Panicum ramosum), japanese (Echinochloa crusgalli var. frumentacea), proso (Panicum miliaceum), and pearl (Pennisetum typhoides) millets - 30 lb/A; grain sorghum (Sorghum bicolor) - 10 lb/A; sorghum sudan-grass (S. bicolor) - 23 lb/A. Natural vegetation was allowed to volunteer in the check plots. All plots were fertilized at the rate of 40 lb/A nitrogen in the form of 21-0-0 as a top dressing after plant emergence.

Stand quality 2 and 5 weeks postemergence, days to 50% heading, plant senescence at October flood-up time, and biomass at fall flood-up were determined for each vegetative type. Stand quality was rated using the following scale (1 to 9) where 1 = no stand and 9 = ideal stand. Days to 50% head emergence was determined by visual estimation. Plant senescence ratings were based on the following scale: 0 = no stem or leaf senescence, 1 = 1 to 10%, 2 = 11 to 20% . . . 9 = 81% or more leaf and stem tissue senescence. Biomass at crawfish pond flood-up was determined by removing all vegetation at ground level within a 25 ft² area using a Kincaid sickle-bar forage harvester. Vegetative samples were dried in a forced air drier at 150°F until a constant weight was attained, and dry matter biomass was determined.

RESULTS AND DISCUSSION

Days to 50% heading ranged from 57.5 for proso millet to 71.8 for browntop millet, and stand qualities as indicated by 2- and 5-week ratings were excellent (Table 1). Dry matter biomass at fall flood-up ranged from 2552 lb/A (browntop millet) to 4659 lb/A for sorghum sudan-grass. Although a relatively wide range in dry matter biomass was observed, few significant differences ($P < 0.05$) were detected. This lack of statistical sensitivity can be attributed to high variability within treatments (Table 1).

Senescence at flood-up ranged from 1.50 (weeds) to 9.75 (proso millet). Senescence of proso millet was highest, followed by browntop and japanese millets; pearl millet, grain sorghum, and sorghum exhibited similar senescence and comprised a third ranking group which was followed by the volunteer vegetation which exhibited the lowest senescence (Table 1).

Nassar (1982) conducted preliminary investigations comparing japanese and browntop millets with rice as crawfish forage. He reported no biomass differences between the two millets, but obtained significantly greater biomass production with rice. Crawfish production was greater in the millet treatments, however. The low production in rice-planted ponds was attributed to poor water quality resulting from the impact of the greater vegetative biomass during decomposition. Miltner and Avault (1981) also obtained greater biomass with rice than with japanese millet, but reported greater crawfish production in the rice-planted ponds. These studies, although superficially contradictory, support findings by Brunson et al. (1985) which indicate differences among rice varieties in suitability for crawfish production. Nassar (1982) planted the variety Saturn, which appears to be one of the least desirable varieties, while Miltner and Avault (1981) utilized the variety Labelle which shows great potential as a crawfish forage.

SUMMARY

The preliminary data reported here indicate that japanese and browntop millets have limited potential as a planted forage for crawfish. Proso millet appears to have little or no potential, while grain sorghum, pearl millet, and sorghum sudan-grass appear worthy of further investigation as alternative forages for crawfish.

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Table 1. Crawfish forage production parameters for seven terrestrial vegetative types. Rice Research Station, Crowley, LA. 1985.

Vegetative type	2-Wk stand	5-Wk ^{1/} stand	Flood-up biomass	Flood-up ^{2/} senescence
			-(1b DM/A)-	
Browntop millet	8.9 a	9.0 a	2552 c	7.8 b
Japanese millet	8.5 a	9.0 a	3397 abc	8.5 b
Proso millet	9.0 a	9.0 a	2855 bc	9.8 a
Pearl millet	8.9 a	9.0 a	4026 ab	4.8 c
Grain sorghum	8.5 a	9.0 a	3519 abc	4.8 c
Sorghum sudan-grass	8.9 a	9.0 a	4659 a	1.5 d
Volunteer weeds	6.0 b	8.0 a	2905 bc	4.8 c

^{1/} Stand ratings based on scale 1 to 9, where 1 = no stand and 9 = ideal stand.

^{2/} Senescence ratings based upon scale 0 to 9, where 0 = no stem or leaf senescence, 1 = 1 to 10%, 2 = 11 to 20% . . . 9 = 81% or more stem or leaf senescence.

abcd/ Means within any column not followed by the same letter are significantly (≤ 0.05) different based on Duncan's multiple range test.

EVALUATION OF COOL TOLERANT RICE FOR CRAWFISH FORAGE

(A Preliminary Report)

M.W. Brunson and E.M. Nowick

INTRODUCTION

In present production systems, the most efficient and dependable method of providing a forage base for crawfish is through the use of a planted, cultivated crop. A number of agronomic crops have been used and evaluated as crawfish forage and by far the most promising is rice (*Oryza sativa*). Crawfish have been harvested incidentally from rice fields for decades and rice has proven superior to other planted forages as well as natural vegetation for crawfish production. Because rice is a semi-aquatic plant, it is easily established and does well in crawfish ponds. It also tends to persist longer during the fall and winter months than do other species which are less adapted to wet conditions.

There are basically two approaches to rice/crawfish culture. In the first, both rice and crawfish are raised as cash crops. Rice is planted in early spring and harvested for grain in late summer. The rice stubble is left standing and ratoon growth is encouraged. The field is reflooded in early fall and crawfish subsist on the decaying rice stubble and green regrowth. In the second approach, rice is planted solely for crawfish, with no concern for grain production. Under this strategy, rice is planted in mid- to late summer and the grain, if any, is not harvested. The entire rice plant then remains to provide crawfish forage. This rice-for-crawfish-only strategy is most often used by landowners participating in governmental "set-aside" programs which mandate later planting dates or by farmers who extend their crawfish harvest season into early summer.

A major problem with rice, as well as all other crawfish forages, is persistence under winter flood conditions. Typically, vegetative forage becomes depleted in mid- to late winter, and as crawfish harvesting intensifies in the spring months little food is available to support crawfish growth and production. This often leads to stunted and consequently unmarketable sized crawfish. The identification of a forage plant which would persist throughout a greater portion of the crawfish production season would eliminate these forage depletions and their concomitant production related problems.

One possibility which exists is the use of cool or cold tolerant rice varieties in the rice-for-crawfish-only system. Cold tolerance would allow these plants to survive longer into the early winter months than do our domestic varieties. This increased longevity could result in greater biomass production, but perhaps more importantly, might extend the period of forage availability later into the spring season, thus providing food for crawfish growth and production at a time when traditional forages are becoming depleted.

MATERIALS AND METHODS

Small seed samples of 64 lines of rice with possible cold tolerance were received from the USDA plant germplasm collection. These lines are native to the countries of Guatemala, Chile, Bolivia, Afghanistan, and Nepal where rice is grown at either high altitudes or high latitudes. Several of the lines were identified as having cold tolerance in screening at IRRI. During the summer of 1985, the lines were grown out for seed increase and an initial evaluation was made. The lines were rated for days to emergence, days to heading, plant height, and a number of identifying traits such as stigma color and blade pubescence.

RESULTS AND DISCUSSION

Of the lines grown, two, PI 223518 and *Italica lavorno*, will be eliminated from further testing because of sensitivity to normally applied rates of Bolero. Several others showed susceptibility to blast. Thirty-eight of the lines will be evaluated during the next growing season for cold tolerance and forage production under the rice-for-crawfish-only system. Because of poor germination, the remaining lines will need to be grown-out for seed increase for one more season.

Most of these lines are not agronomically acceptable for rice cash crop production but may be useful as sources of cold tolerance for spring-planted rice cropping, both to improve early seedling vigor and fall persistence for crawfish forage.

ACUTE AND CHRONIC TOXICITY OF METHIOCARB TO SELECTED AQUATIC ORGANISMS

(A Final Report)

M.W. Brunson, E.A. Wilson, and W.L. Goodfellow^{1/}

INTRODUCTION

At the request of Borderland Products, Inc., the Rice Research Station, in cooperation with E.A. Engineering Science and Technology, Inc. performed static acute, flow-through acute, and static-renewal chronic toxicity assays on technical grade 3,5-dimethyl-4-(methylthio)phenol methylcarbamate (methiocarb). Methiocarb is the active ingredient in Borderland Red, a bird repellent compound for which Borderland Products is seeking a label for use as a rice seed treatment. Borderland Red was marketed in Louisiana in 1984 and 1985 under Section 18 of FIFRA. This product is used primarily in water-seeded fields, since these systems are most vulnerable to bird depredations. The United States Environmental Protection Agency requested these studies due to concerns relative to methiocarb residues in rice fields and in effluent waters. The objective of the acute tests was to determine 96-hour median lethal concentrations of the technical product using Menidia menidia (Atlantic silverside) and Palaemonetes pugio (grass shrimp) under static conditions, and Crassostrea virginica (American oyster) under flow-through conditions. Lethality was the end point for the acute tests, with the exception of C. virginica, in which the end point was measured shell deposition. The objective of the chronic test was to determine the Maximum Allowable Toxic Concentration (MATC) of the technical product using Daphnia magna (water flea) exposed for 21 days under static-renewal test conditions. The end points for the chronic test were lethality and fecundity. This report presents the results of the toxicity tests.

MATERIALS AND METHODS

TECHNICAL PRODUCT DESCRIPTION

The technical product tested was 3,5-dimethyl-4-(methylthio)phenol methylcarbamate (methiocarb). The sample of the technical product was from Formula No. 605250, Batch No. 5030085, and was listed by Mobay Chemical Corporation as 99% pure.

Stocks of various nominal concentrations of methiocarb were prepared for each test species, based on the results of preliminary range-finding tests. The solubility of the technical product at 68°F was reported by Mobay Chemical Corporation as 10 ppm. The stocks were prepared by adding technical product into either water (for stocks of ≤10 ppm) or acetone (for stocks >10 ppm) and mixing on a stir plate until the technical product was dissolved. For preparation of stocks approaching 10 ppm of methiocarb in water, it was necessary to

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elevate the temperature of the solution to approximately 95 to 104°F. The nominal concentrations of the various methiocarb stocks used in this study were: 10 ppm for the Daphnia magna chronic test; 270, 2,700, and 27,000 ppm (in acetone) for the grass shrimp, American oyster, and Atlantic silverside acute tests.

General toxicity test methods were similar to, and conducted in accordance with, APHA et al. (1981), ASTM (1980), and U.S. EPA (1985). Specific test protocols and quality control procedures are described in EA's protocols found in EA's Quality Control and Standard Operating Procedures Manual (EA, 1981).

WATER FLEA (D. magna). A preliminary range-finding test was performed to determine concentrations to be used for the definitive 21-day chronic toxicity test. Based on the range-finding test results, the definitive chronic toxicity test was initiated at 1430 hours on October 21, 1985 and terminated on November 11, 1985 at 1415 hours. Five nominal test concentrations (0.0024, 0.0042, 0.0075, 0.0135, and 0.0240 ppm methiocarb) and a dechlorinated tap water control were used. Forty neonates (<24 hours old) were transferred randomly to each of six culture bowls containing 1.06 qt of test solution. Before the maturing D. magna released any neonates, the organisms were separated into treatment groups consisting of 10 replicates for each test concentration: seven beakers containing one daphnid each (for collection of data on survival, growth, and reproduction); and three beakers containing five daphnids each for collection of data on survival only. Among treatment groups, no statistically significant ($\alpha = 0.05$) mortality existed for the first 4 days (organisms transferred on Day 4). Test solutions were renewed every Monday, Wednesday, and Friday by transferring the organisms to test containers with fresh test solution. The organisms were fed a combination of trout chow/yeast food and the algae, Selenastrum capricornutum.

Observations of mortality and reproduction were made during each test solution renewal. A slight prodding of an organism was occasionally necessary to distinguish between those animals which were dead and those which were immobilized. Water quality determination during the test was performed on one replicate of each treatment group for both old and fresh test solution. Water quality parameters monitored included temperature, pH, and DO. Test vessels were not aerated and were kept on a 16-hour light/8-hour dark photoperiod.

To test for statistically significant differences between treatment group mean growth (length) and reproduction (young/female) in the D. magna chronic tests, data were subjected to one-way analysis of variance (ANOVA). If a significant difference between the treatment group means in the test was detected by ANOVA at the 0.05 significance level, a Tukey's studentized range test was performed on the data to rank the significant and nonsignificant treatment means. From these analyses, a No Observable Effect Concentration (NOEC) and Lowest Observable Effect Concentration (LOEC) were determined for each chronic test where significant differences existed between treatment group means. A MATC was then calculated as the geometric mean of the NOEC and the LOEC.

AMERICAN OYSTER (C. virginica). A static preliminary range-finding test was used to determine the concentration to be used in the definitive flow-through acute toxicity test. The acute flow-through testing was conducted using an Ace Glass proportional diluter. This diluter system is a modified version of the proportional diluter described by Mount and Brungs (1967).

During test operation, a methiocarb stock solution (with acetone vehicle) equal to the highest test concentration was prepared with synthetic seawater and delivered through the lower tier of diluter cells. This stock was diluted to the desired test concentrations with synthetic seawater delivered through the upper tier of cells. An additional cell was used to deliver the same concentration of acetone used as the vehicle in the stock solution. The volume delivered by each cell was calibrated prior to test initiation by means of Class A glassware. The diluter was calibrated to provide nominal concentrations of 0.56, 1.0, 1.8, 3.2, and 5.6 ppm methiocarb, a vehicle control (acetone), and a synthetic seawater control. The maximum concentration of acetone in the highest test concentration and vehicle control was 0.005 ppt.

Dilution water and methiocarb stock solutions were supplied, respectively, from 106- and 53-gal polyethylene drums to separate glass aquaria, which acted as constant head tanks for delivery to the diluter. Overflow from the head tanks and diluter cells was returned to holding drums. The test chambers used in this test were 11.8 x 5.7 x 7.9 in, 1.77 gal aquaria constructed of lead-free glass, bonded with clear silicone sealant. Each aquarium was fitted with a drain tube, and test solution was introduced through tubing at the opposite end of the bottom. The aquaria were placed in the thermally controlled water bath maintained at $68 \pm 3.6^{\circ}\text{F}$.

Test aquaria were allowed to fill via cycling of the diluter after calibration. Each diluter cycle was approximately 15 minutes in length, with each cycle delivering .07 gal of solution. This provided more than five 90% replacement volumes during a 24-hour period to each test chamber. The cell volumes and cycle length were checked daily and adjusted as necessary. The photoperiod was a 16-hour light/8-hour dark cycle.

The shells of the oysters were filed to a uniform rounded edge as described in APHA et al. (1981) and EPA (1985); shell height was measured to the nearest 0.0004 in with dial calipers. All oysters were numbered and randomly placed, 10 organisms per chamber. The oysters were fed 8.5 oz of 1.5% cornstarch/yeast solution a minimum of twice daily, supplemented with the algae Selenastrum capricornutum.

Shell deposition, as well as mortality, were used to measure toxicity because of the observational difficulty occasionally encountered when mortality is the sole end point for an acute toxicity study with this species (Goodfellow et al., 1983).

It is well established that bivalves have the ability to close their shells and protect themselves from certain toxicants on a short-term basis if the concentration is above a certain "detectable" threshold (Richardson et al., 1982). The acute toxicity response was evaluated as a shell deposition EC50 since the 96-hour LC50 could not be calculated in this study (>5.6 ppm methiocarb) because of insufficient mortality. The EC50 is defined as the median effective concentration of a compound in solution which causes a 50% reduction in shell deposition of the test organisms relative to the controls.

Statistically significant differences between exposure groups' shell depositions were evaluated using both the acetone control and the control dilution water. The data were subjected to one-way ANOVA. If a significant

difference between the treatment group means in the test was detected by ANOVA ($\alpha = 0.05$), a Tukey's studentized range test was performed on the data to rank the significant and nonsignificant treatment means. To obtain a shell deposition EC50, it was necessary to calculate the ratio of the mean shell growth for each treatment group to the mean shell growth of the acetone control organisms and converted to a percent decrease in shell deposition. From these ratios, an EC50 was calculated using the SAS probit analysis procedure (SAS Institute, Inc.).

Observations of mortality were made at 24, 48, 72, and 96 hours; however, shell deposition was only measured at the end of the 96-hour period. Death was defined as the oyster's inability to close valves following mechanical prodding. Water quality determinations were made at test initiation and daily for DO, temperature, salinity, and pH in each test chamber. The definitive assay was initiated at 1345 hours on October 30, 1985 and terminated on November 3, 1985 at 1635 hours.

ATLANTIC SILVERSIDE (M. menidia). A definitive 96-hour static test was performed using nominal test concentrations of 0.005, 0.01, 0.04, 0.10, 0.18, 0.32, 0.56, 1.0, and 1.8 ppm methiocarb, with an acetone vehicle control and a control dilution water. The maximum concentration of acetone was 0.007 ppt. Ten juvenile Atlantic silversides were randomly placed in each 5-gal test chamber containing 4 gal of test solution. Each treatment concentration and control consisted of two replicates. The acute test was initiated at 1252 on October 15, 1985 and terminated at 1456 on October 19, 1985. Test chambers were kept at $68 \pm 3.6^{\circ}\text{F}$ and were not aerated. Water quality determinations were made daily for DO, temperature, salinity, and pH. The photoperiod was a 16-hour light/8-hour dark cycle and the fish were not fed during testing.

Observations were made at 0, 24, 48, 72, and 96 hours to determine the number of survivors in each replicate; this information was recorded on the data sheet. Physical prodding was occasionally necessary to determine if a fish was dead or immobilized. Calculation of LC50 values at 96 hours by the binomial, moving average, and probit analysis methods were performed as described by Stephan (1977).

GRASS SHRIMP (P. pugio). Grass shrimp were tested under a 96-hour static-test conditions, using five nominal test concentrations (0.0012, 0.0032, 0.018, 0.0349, and 0.135 ppm methiocarb), an acetone vehicle control (0.007 ppt), and a dilution water control. Each treatment concentration and control consisted of two replicate 5-gal test aquaria containing 4 gal of test solution. The test was initiated on October 22, 1985 at 1215 and terminated on October 26, 1985 at 1208. Ten juvenile grass shrimp were randomly placed in each test chamber. The chambers were kept at $68 \pm 3.6^{\circ}\text{F}$ and were not usually aerated during testing. Because DO levels fell below the 60% saturation after 48 hours, it was necessary to aerate gently all test chambers in order to elevate the DO levels. Water quality determinations were made daily for DO, temperature, salinity, and Ph. The photoperiod was a 16-hour light/8-hour dark cycle. Test organisms were not fed during testing.

Observations were made at 0, 24, 48, 72, and 96 hours to determine the number of survivors in each replicate and were recorded on the data sheet. A slight prodding of the shrimp was occasionally necessary to distinguish between animals alive or dead. Calculation of LC50 values at 96 hours by the binomial, moving average, and probit analysis methods followed Stephan (1977).

Reference toxicant bioassays, using sodium dodecyl sulfate (SDS) were performed as an internal quality check of the sensitivity of each lot of test organisms. Testing was concurrent with definitive tests of D. magna, M. menidia, and P. pugio. A reference toxicant assay was not performed on C. virginica because of the difficulty in short-term bioassays producing a lethal end point with oysters and lack of a database on shell deposition with regard to a reference toxicant.

The results of each static reference toxicant test (LC50 value) was compared to prior toxicological information from EA's Aquatic Toxicology Laboratory to determine if the results were within acceptable limits.

RESULTS AND DISCUSSION

The 96-hour LC50 and 95% confidence interval for Atlantic silversides exposed to methiocarb is presented in Table 1. This LC50 value was obtained by the moving average method, which gave the best fit. No mortality was observed in the synthetic seawater control and only 5% mortality was observed in the acetone vehicle control. Within the first 24 hours, 100% mortality occurred at nominal concentrations of ≥ 0.10 ppm. Silversides did not appear to be affected acutely by nominal concentrations of ≤ 0.04 ppm (based on allowable 10% in controls). The NOEC was 0.04 ppm and the LOEC was 0.10 ppm. Thirty Atlantic silversides were randomly sampled from this lot of fish (No. MM-040) for length/weight measurements. The data for this lot of fish were: mean standard length ($\pm$ S.D.) = 1.04 ($\pm$ 0.07) in and mean wet weight ($\pm$ S.D.) = 0.007 ($\pm$ 0.002) oz. Biomass loading per test chamber was approximately 0.00002 oz (wet weight)/gal.

The 96-hour LC50 and 95% confidence interval for grass shrimp exposed to methiocarb are presented in Table 2. The LC50 value was calculated by the moving average method which gave the best statistical fit. No mortality was observed in either the synthetic seawater or acetone vehicle controls.

Concentrations of methiocarb ≤ 0.0180 ppm (nominal) did not appear to affect the grass shrimp acutely (based on allowable 10% mortality in controls). The NOEC and LOEC were 0.018 and 0.049 ppm, respectively. Length/weight data for this lot of organisms (No. PP-002) were: mean total length ($\pm$ S.D.) = 1.07 ($\pm$ 0.15) in and mean wet weight ($\pm$ S.D.) = 0.005 ($\pm$.003) oz for 30 surviving grass shrimp randomly sampled from the definitive assay. The approximate loading rate was 0.00002 oz (wet weight)/gal.

Table 3 presents the mean net shell deposition of oysters exposed to various nominal concentrations of methiocarb; the 96-hour shell deposition EC50 is presented in Table 4. A statistically significant ($\alpha = 0.041$) difference existed between the dilution water control and the acetone control, with the acetone controls having a larger net shell deposition. Since all treatment groups used acetone as the compound vehicle, the shell deposition EC50 was calculated using the shell deposition of the acetone controls instead of the dilution water controls. The resultant EC50 value is a more conservative estimate (i.e., lower EC50 value) using this approach. Due to the nature of the data, 95% confidence limits could not be calculated for the shell deposition EC50 value using probit analysis. See Finney (1971, pp. 76-80) for a discussion on confidence limits.

Table 1. Percent survival of Menidia menidia exposed to various concentrations of methiocarb. Rice Research Station, Crowley, LA. 1985.

Nominal concentrations	Percent survival (20 individuals/concentration)			
	24 Hours	48 Hours	72 Hours	96 Hours
Control	100	100	100	100
Acetone control (0.007 ppt)	100	95	95	95
0.005 ppm	100	100	100	100
0.01 ppm	100	95	95	95
0.04 ppm	95	95	95	90
0.10 ppm	0	0	0	0
0.18 ppm	0	0	0	0
0.32 ppm	0	0	0	0
0.56 ppm	0	0	0	0
1.0 ppm	0	0	0	0
1.8 ppm	0	0	0	0

Calculated 96-Hour LC50 and 95% Confidence Intervals

<u>Binomial</u>	<u>Moving Average^{a/}</u>	<u>Probit</u>
0.057 ppm (0.04-0.10)	0.051 ppm (0.039-0.068)	0.051 ppm (0-infinity)

No Observable Effect Concentration (NOEC) = 0.04 ppm.

Lowest Observable Effect Concentration (LOEC) = 0.10 ppm.

^{a/} Most appropriate statistical method based on goodness of fit.

Table 2. Percent survival of Palaemonetes pugio exposed to various concentrations of methiocarb. Rice Research Station, Crowley, LA. 1985.

Nominal concentrations	Percent survival (20 individuals/concentration)			
	24 Hours	48 Hours	72 Hours	96 Hours
Control	100	100	100	100
Acetone control (0.007 ppt)	100	100	100	100
0.0012 ppm	100	100	100	100
0.0032 ppm	100	100	90	90
0.0180 ppm	100	95	90	90
0.049 ppm	85	85	70	70
0.135 ppm	35	15	10	5

Calculated 96-Hour LC50 and 95% Confidence Intervals

<u>Binomial</u>	<u>Moving Average^{a/}</u>	<u>Probit</u>
0.065 ppm (0.049-0.135)	0.065 ppm (0.047-0.080)	0.051 ppm (0-infinity)

No Observable Effect Concentration (NOEC) = 0.0180 ppm.

Lowest Observable Effect Concentration (LOEC) = 0.049 ppm.

^{a/} Most appropriate statistical method based on goodness of fit.

Table 3. Net shell deposition ($\pm$ S.D.) of *Crassostrea virginica* exposed to various concentrations of methiocarb. Rice Research Station, Crowley, LA. 1985.

Nominal concentration	Net shell deposition (.001 in)			Ratio of shell deposition ^{a/}	Percentage deposition reduction ^{b/}
	Rep. A	Rep. B	Pooled		
Control	16.54 (8.27)	17.72 (8.27)	16.93 (7.87)	---	---
Acetone control (0.005 ppm)	26.38 (14.96)	22.83 (10.63)	24.41 (12.6)	100	0
0.56 ppm	21.26 (12.20)	18.11 (17.72)	20.08 (14.57)	82.26	17.74
1.00 ppm	4.33 (5.51)	13.78 (15.75)	9.06 (12.60)	37.10	62.90
1.80 ppm	0.79 (1.97)	3.94 (5.51)	2.36 (4.33)	9.68	90.32
3.20 ppm	5.12 (6.30)	0.39 (6.69)	2.36 (4.72)	9.68	90.32
5.60 ppm	0.16 (0.39)	0.00 (0.00)	0.08 (0.28)	0.32	99.68

^{a/} The ratio of shell deposition is mean shell deposition of exposed oysters $\times$ 100.
acetone control oysters

^{b/} The percentage of deposition reduction is $100 - (\text{ratio of shell deposition})$. This value is used in the 96-hour EC50 calculation.

Table 4. Tukey's studentized range test and 96-hour shell deposition EC50 of Crassostrea virginica exposed to various concentrations of methiocarb. Rice Research Station, Crowley, LA. 1985.

Tukey's studentized range test of shell deposition^{a/}

<u>Control</u>					
<u>0.56 ppm</u>	<u>Control</u>	<u>1.0 ppm</u>	<u>3.2 ppm</u>	<u>1.8 ppm</u>	<u>5.6 ppm</u>

No Observable Effect Concentration (NOEC) = 1.0 ppm.

Lowest Observable Effect Concentration (LOEC) = 1.8 ppm.

Maximum Allowable Toxic Concentration (MATC)^{b/} = 1.34 ppm.

<u>Acetone Control</u>					
<u>Acetone control</u>	<u>0.56 ppm</u>	<u>1.0 ppm</u>	<u>3.2 ppm</u>	<u>1.8 ppm</u>	<u>5.6 ppm</u>

NOEC = 0.56 ppm

LOEC = 1.0 ppm

MATC = 0.75 ppm

Calculated 96-hour shell deposition EC50 Value^{c/}

1.0 ppm^{d/}

^{a/} Treatment groups sharing the same underlines are not significantly ($\alpha = 0.05$) different.

^{b/} The MATC is the geometric mean of the NOEC and LOEC.

^{c/} Calculated by the SAS Probit Procedure (SAS Institute, Inc.).

^{d/} The 95% confidence limits could not be calculated.

The NOEC, LOEC, and MATC are also presented in Table 3 and 4. The mean ($\pm$ S.D.) shell height of 30 oysters for this lot (No. AO-001) was 0.589 ($\pm$ 0.09) in.

Table 5 presents the percent survival and young produced per surviving female of Daphnia magna exposed for 21 days to methiocarb. Based on young production, the NOEC for D. magna exposed for 21 days to methiocarb was 0.0135 ppm and the LOEC was 0.024 ppm. The MATC value for this assay was 0.018 ppm. A significant difference ($\alpha = 0.05$) of young production exists with D. magna exposed to 0.024 ppm methiocarb and all other treatment groups (Table 5). No significant difference ($\alpha = 0.05$) was observed in the mean total length of D. magna with regard to the treatment groups.

The reference toxicant used was sodium dodecyl sulfate (SDS). All test species were exposed to a range of 0, 2.5, 5, 10, 20, and 40 ppm SDS for the same duration as the definitive test for that species. Reference toxicant LC50s for D. magna, M. menidia, and P. pugio were all within expected ranges of static assays for EA's Aquatic Toxicology Laboratory. The LC50 values and 95% confidence intervals were D. magna, 48-hour LC50 = 20.8 (15.4 to 28.3) ppm; M. menidia, 96-hour LC50 = 7.5 (5.0 to 10.0) ppm; and P. pugio, 23.4 (20.0 to 40.0) ppm.

Table 5. Percent survival and young per surviving female Daphnia magna exposed for 21 days to various concentrations of methiocarb. Rice Research Station, Crowley, LA. 1985.

Nominal concentration	Percent survival during first 4 days ^{a/}	Percent survival during remaining 17 days ^{b/}	Young per surviving female ^{c/}	Mean total length per surviving female
Control	100	81	78.2 ($\pm$ 13.0) N=5	0.17 ($\pm$ 0.020) in N=5
0.0024 ppm	95	50	89.5 ($\pm$ 3.1) N=4	0.17 ($\pm$ 0.02) in N=3
0.0042 ppm	98	64	87.8 ($\pm$ 12.6) N=5	0.17 ($\pm$ 0.02) in N=5
0.0075 ppm	100	68	90.0 ($\pm$ 16.5) N=3	0.16 ($\pm$ 0.02) in N=3
0.0135 ppm	100	54	54.8 ($\pm$ 24.1) N=5	0.16 ($\pm$ 0.02) in N=5
0.0240 ppm	95	9	0 N=0	0 N=0
Tukey's studentized range test on young production ^{d/}				
0.0075 ppm	0.0024 ppm	0.0042 ppm	Control	0.0135 ppm
No Observable Effect Concentration (NOEC) = 0.0135 ppm				
Lowest Observable Effect Concentration (LOEC) = 0.0240 ppm.				
Maximum Allowable Toxic Concentration (MATC) ^{e/} = 0.018 ppm.				

a/ Based on 40 individuals per test concentration.

b/ Based on 22 individuals per test concentration, except in controls which had 21 individuals.

c/ Young produced by females surviving entire 21 days of exposure.

d/ Treatment groups within same groupings (grouped by the underlines) are not significantly ($\alpha = 0.05$) different.

e/ The MATC is the geometric mean of the NOEC and LOEC.

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DOUBLE CROPPING CRAWFISH WITH RICE AND GRAIN SORGHUM

(A Preliminary Report)

M.W. Brunson and J.L. Griffin

INTRODUCTION

Crawfish (Procambarus spp) have been harvested from Louisiana rice (Oryza sativa L.) fields for decades, and the two commodities have been double cropped since the 1960's (Thomas 1963). The expansion of crawfish production into a bona-fide industry (120,000 acres in 1985), and the concomitant intensification of cultural practices have resulted in a demand for additional or alternative crops to double crop with crawfish. One agronomic crop which has demonstrated potential in this regard is grain sorghum [Sorghum bicolor (L.) Moench]. Grain sorghum acreage has increased in recent years because farmers have become interested in alternatives to soybeans [Glycine max (L.) Meir] for use in their farming enterprises. With the increase in acreage in the south Louisiana area crawfish farmers are also interested in using this crop in conjunction with their crawfish production. Preliminary studies indicate that grain sorghum may be well suited to application in a crawfish double cropping system (Brunson et al. 1985).

This study was conducted to compare sorghum/crawfish and rice/crawfish double cropping systems in south Louisiana.

MATERIALS AND METHODS

The study was conducted in eight 0.3 A ponds located at the South Unit of the Rice Research Station in Crowley, Louisiana. All ponds had previously been in crawfish production and contained resident populations of crawfish. Therefore, no crawfish were stocked during this study. Four ponds each were randomly assigned to either rice or grain sorghum systems, and were planted in early June. 'Mars' rice was drill seeded at the rate of 90 lb/A on June 6 into a prepared seedbed, and 'R1090' grain sorghum was planted on 30-in row spacings into a similar seedbed on June 7. Fertilizer at the rate of 60-60-60 (N-P₂O₅-K₂O) was broadcast incorporated prior to planting both rice and grain sorghum. Rice was flushed to encourage stand development, and propanil (4 lb ai/A) was applied on June 26 for weed control. Rice was permanently flooded following propanil application. A tank mix of Dual at 2.0 lb/A plus atrazine at 1.5 lb/A was surface applied after planting on the sorghum plots. Stand densities were estimated visually 3 weeks after planting and classified as excellent, good, mediocre, or poor.

Both crops were combine harvested at grain maturity; grain sorghum was harvested on September 16 and rice was harvested on September 28. Grain yields were determined and adjusted to 12% and 13% moisture for rice and sorghum, respectively. In all ponds the straw spreader on the combine was disconnected to allow straw and residue to fall into wind rows behind the combine.

Ponds were flooded to a depth of 15 inches for crawfish production on October 10 and a flood was maintained throughout the winter. At flood-up a 25 ft² sample of vegetation was taken from each pond to determine the amounts of straw/stubble residual from grain harvest as well as the biomass of green ratoon growth present. Similar samples were taken at 6-wk intervals throughout the crawfish harvest season. All samples were dried in a forced air drier at 150°F until reaching a constant weight and dry matter biomass was determined.

To maintain dissolved oxygen (D.O.) above critical levels, D.O. was monitored in each pond throughout the season. When dawn D.O. levels dropped below 2 ppm, aerated water was flushed through the ponds for several hours.

Beginning in mid-February crawfish were trapped daily using 3-flue pyramid traps at a density of 30 traps per acre. Traps were initially baited with cut fish, but later in the season one of several commercially manufactured crawfish baits was used. Between February 14 and May 23 a total effort of 74 trap-days was expended.

RESULTS AND DISCUSSION

Stands for sorghum were excellent, but for rice were only mediocre. Grain production in the sorghum ponds averaged 2098 lb/A (Table 1). This relatively poor sorghum production can be primarily attributed to heavy insect pressure as a consequence of the necessarily late planting date as well as inadequate fertility levels. Rice production was likewise low, and two factors probably attributing to these results were low stand densities resulting from poor seed germination and inadequate fertility levels. A mean yield of only 2683 lb/A of rice was measured (Table 1). Analysis revealed no significant difference in grain production between rice and grain sorghum.

Table 1. Grain, vegetative production, and biomass persistence of rice and grain sorghum in double cropped crawfish ponds. Rice Research Station, Crowley, LA. 1985-86.

Vegetation	Grain (12% H ₂ O)	DM biomass production (lb/A)					
		Straw	Ratoon	Total	6 wk	12 wk	18 wk
Grain Sorghum	2098	2099	2098	4197	1828	616	256
Rice	2683	2683	574	3257	1447	1112	653
Mean	2466	2390	1336	3727	1637	864	455
CV (%)	21.1	33.5	16.6	23.8	26.3	14.1	12.1
LSD (0.05)	NS	NS	306	NS	NS	168	75

Straw dry matter (DM) production averaged 2099 lb/A for grain sorghum and 2683 lb/A for rice (Table 1). Because of high variation no significant differences were detected ($P>0.05$). Significant differences in ratoon responses, however, were detected. Grain sorghum regrowth was nearly four times that of rice (2098 vs. 574 lb/A DM; Table 1). Total DM biomass at flood-up, representing the sum of straw + ratoon growth, averaged 4197 lb/A for grain sorghum and 3257 lb/A for rice. Because of the high variability in straw DM biomass, no differences were detected.

No difference in D.M. biomass was detected until 12-wk post-flood. Six weeks after flood the rate of disappearance of the grain sorghum accelerated more rapidly than that for rice (Table 1). At 12-wk post-flood rice comprised greater biomass ($P<0.05$) than sorghum, and this significance remained through the remainder of the season.

Average crawfish productions in ponds with the two vegetative types were similar ($P>0.10$; Table 2). Mean season-long production in sorghum ponds was 2323 lb/A, whereas production in rice ponds was 2299 lb/A. Trapping effort in all ponds was identical (74 trap days) and catch/trap/day was 15.07 oz in sorghum ponds and 14.91 oz in rice ponds ($P>0.25$).

These studies will be conducted a second year in 1986-87 to further define the potential of sorghum/crawfish double cropping as compared with double cropping rice and crawfish.

Table 2. Crawfish production data from double cropped rice and sorghum ponds. Rice Research Station, Crowley, LA. 1985-86.

Replication	Crawfish production (lb/A)	
	Sorghum (lb/A)	Rice (lb/A)
1	2159	1994
2	1967	2437
3	2584	2394
4	2581	2370
Mean	2323	2299

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SUMMER PLANTED RICE FOR CRAWFISH MONOCROPPING

(A Preliminary Report)

M.W. Brunson and B.J. Hoff

INTRODUCTION

Rice has proven to be one of the best of all planted forages for crawfish (Avault et al. 1983), and currently is utilized in at least 70% of Louisiana's 120,000 acres of commercial crawfish ponds. Basically, two strategies can be employed in utilizing rice as a forage for crawfish: double cropping, where both rice and crawfish are managed as cash crops; and monocropping, where rice is planted solely to provide a forage base for crawfish. The rice-for-crawfish-only strategy has become popular with landowners who participate in federal crop set-aside programs, since late summer planting of rice for crawfish is permitted. This type of rice utilization has some apparent advantages, but these have yet to be confirmed experimentally. One advantage is that only green, thriving plants are flooded in October, as opposed to stubble, straw, and a limited amount of green vegetation in a double cropped system. This potentially should reduce the demand on oxygen levels which is typically observed in ponds with large amounts of stubble and straw. Additionally, because late planted rice would be alive at fall flood-up, it might persist longer through the winter than stubble which has already begun to decay at flood-up. Thus, food may be available longer into the spring months in this type of system.

The objective of this study was to evaluate 30 rice varieties for their potential in an August planted rice-for-crawfish-only system.

MATERIALS AND METHODS

Thirty rice varieties were drill seeded at the rate of 90 lb/A into 8-in rows using a seven row Kincaid cone planter on August 10, 1985. Plots measured 4.7 x 30 ft, and the study was arranged in a randomized complete block design with four replications. Rice was flushed immediately after planting and periodically thereafter to maintain adequate soil moisture for plant development. No fertilizers or pesticides were applied.

Stand quality ratings were made 2- and 5-wk post-emergence using the 1 to 9 rating scale where 0 = no stand and 10 = ideal stand. Days to 50% head emergence were determined for each variety by visual observation. All plots were flooded on October 10 to a depth of approximately 14 in, and the flood was maintained throughout the winter and spring. Plant canopy height at flood-up was measured, and dry matter biomass at flood-up was determined for each variety by harvesting all biomass in a 25 ft² area. Available vegetative biomass was determined thereafter at 6-wk intervals by hand harvesting all biomass from previously unharvested 10 ft² areas in each plot. All vegetative

samples were dried in a forced air drier at 150°F until a constant dry weight was attained, and dry matter biomass was determined. Soil samples were taken from the experimental area and analyzed to determine inherent fertility levels.

RESULTS AND DISCUSSION

The 1985 fall season was warmer than average with the first frost occurring on November 27. However, this first frost did not kill the plants and the only visible damage was tip burning on the upper leaves. The short duration of the frost period and the latent heat in the flood water apparently minimized frost damage. All varieties remained green and the late maturing varieties continued to grow until the first killing frost (December 17). Growth and heading progress were considerably slower after the first frost, apparently due to frost damage and cooler ambient temperatures (Table 1).

The second sampling (6-wk post-flood) appears to have coincided with the maximum biomass production of the very early varieties Labelle and Bond (Table 2). Early maturity appears to limit biomass production since the biomass of these varieties increased very little, or decreased, after 6-wk post-flood while some late maturing varieties such as Zenith and Dawn more than doubled their biomass between 6- and 12-wk post-flood. These differences were observed despite the fact that biomass yields of these varieties were similar at flood-up.

Moderately tall varieties appeared to yield more total biomass with greater persistence during the winter crawfish season than the short varieties. However, varieties Nato and Saturn with a mature height of about 42 to 46 inches when spring planted did not yield well under the conditions of this test. Perhaps these varieties are more susceptible to cool temperatures than other tall varieties in this test.

Among the more commonly grown varieties for which seed should be readily available, Starbonnet, Newbonnet, and Mars yielded the most promising results based on this single year's data. Although certain old line varieties such as Zenith, Dawn, and Bonnet 73 appear to be somewhat more productive, additional testing will be required to determine if these advantages are sufficient to justify seed increases of these varieties for crawfish forage applications. This study will be repeated in the 1986-87 research year.

Table 1. Planting to fall-flood parameters for 30 rice varieties planted in August for crawfish monoculture. Rice Research Station, Crowley, LA. 1985.

Variety	Stand ratings		Days to 50% head		Height (in)	
	2-wk	5-wk	August planted	Spring planted ^{1/}	At flood-up	At maturity when spring planted ^{1/}
Lemont	9.0	10.0	89	84	19	33
Leah	9.0	10.0	108	85	22	39
Labelle	9.0	10.0	78	72	22	43
Mars	9.0	10.0	104	84	26	43
Bond	9.0	10.0	77	72	22	40
Lebonnet	1.0	1.0	89	81	21	45
Newrex	9.0	10.0	88	78	22	40
Dawn	9.0	10.0	117	85	27	48
Toro 2	9.0	10.0	100	82	23	40
Tebonnet	9.0	10.0	76	76	21	45
L-202	9.0	10.0	81	70	17	32
Zenith	9.0	10.0	112	85	35	54
Toro	9.0	10.0	131	100	25	55
Magnolia	9.0	10.0	116	84	29	52
Bluebonnet 50	8.5	9.5	133	96	27	50
Northrose	7.5	8.8	102	84	28	48
Saturn	9.0	10.0	107	84	28	48
Starbonnet	9.0	10.0	135	92	24	45
Newbonnet	9.0	10.0	112	86	24	40
Skybonnet	9.0	10.0	85	76	22	42
Pecos	7.3	8.5	89	78	22	41
Carolina Gold	1.0	1.0	135	88	30	58
Honduras	5.3	6.5	135	88	33	61
Rexoro	9.0	10.0	---	132	25	49
Nova 76	9.0	10.0	96	82	25	42
Nato	9.0	10.0	103	84	29	50
Nortai	9.0	10.0	112	85	22	41
Bonnet 73	9.0	10.0	110	88	28	44
Melrose	9.0	10.0	95	74	25	50
Bellevue	9.0	10.0	135	92	25	52
Mean	8.2	9.2	135		25	
CV%	3.9	2.7	2.7		1.8	
LSD (0.05)	0.5	0.4	5.2		3.2	

^{1/} Values in this column are averages for the varieties when planted in the spring under normal grain production conditions.

Table 2. Forage production and biomass persistence of 30 rice varieties planted in August for crawfish monoculture. Rice Research Station, Crowley, LA. 1985-86.

Variety	Post-flood biomass (lb/A dry matter)			
	Flood-up	6-wk	12-wk	18-wk
Lemont	1605	2992	893	276
Leah	1806	2579	1749	2044
Labelle	2175	2044	1260	916
Mars	1739	3579	2135	1415
Bond	2155	2497	1430	878
Lebonnet	1755	302	78	----
Newrex	2033	2523	2061	1396
Dawn	1817	3708	2504	1854
Toro 2	1887	2984	2548	1456
Tebonnet	2241	2665	1272	1022
L-202	1583	2193	1027	813
Zenith	1995	4402	2778	1907
Toro	1645	2811	1689	1701
Magnolia	1985	2924	2341	1387
Bluebonnet 50	1817	2593	1753	2121
Northrose	1745	2847	1677	1415
Saturn	1993	3176	2243	1730
Starbonnet	1797	3018	2233	1943
Newbonnet	1957	3582	2093	1471
Skybonnet	1952	2901	1760	991
Pecos	1704	3236	984	1413
Carolina Gold	1711	412	88	----
Honduras	1707	2584	2044	1315
Rexoro	1766	2550	2147	1751
Nova 76	1752	3356	1967	1607
Nato	1886	3202	1770	1303
Nortai	1641	3164	2274	1574
Bonnet 73	1841	3600	2749	2059
Melrose	1677	3090	1840	1134
Bellevue	1794	3081	2468	1986
Mean	1838	2819	1794	1375
CV%	12.1	23.6	26.1	32.1
LSD (0.05)	313	935	660	624

FORAGE CROPS TISSUE CULTURE RESEARCH

BERMUDAGRASS IMPROVEMENT THROUGH TISSUE CULTURE

(A Preliminary Report)

S.S. Croughan

INTRODUCTION

Bermudagrass is grown extensively throughout Louisiana for hay and pasture. It is planted on over 700,000 acres and is the main forage for the state. Improvement is needed in the ability of bermudagrass to withstand environmental and biological problems. Also needed are improvements in the forage quality of the grass.

The potential exists to develop new germplasm and bermudagrass varieties through the use of tissue culture techniques. Two approaches are commonly utilized in crop improvement programs. One approach is to screen cultured cells for a desirable trait and then to regenerate plants from the selected cells. For example, bermudagrass cells could be exposed to the toxin produced by Helminthosporium cynodontis. Cells resistant to the toxin could be isolated and induced to form plants. The regenerated plants would then be evaluated for resistance to Helminthosporium cynodontis. This technique has been used successfully to develop corn resistant to Helminthosporium maydis, tobacco tolerant to salinity and corn resistant to a herbicide.

The other approach is to regenerate plants from nonselected cells at a high frequency and then screen the plants for desirable traits. The genetic variability typically observed among regenerated plants is referred to as somaclonal variation. Variation is found in several types of characteristics such as plant height, photoperiod response, and disease tolerance. The somaclonal variation approach has been used successfully in several programs. Sugarcane was developed with improved resistance to Helminthosporium sacchari, and several significant genetic alterations in potatoes were found, including maturity date, tuber uniformity, growth habit, and disease resistance.

The objectives of this project are to use tissue culture techniques to develop improved characteristics in hybrid bermudagrass varieties adapted to Louisiana.

MATERIALS AND METHODS

The techniques for bermudagrass cell culture are not yet well established. The initial work in this project has focused on developing optimal conditions for callus initiation and maintenance, and plant regeneration. Several varieties of bermudagrass are being evaluated in this program. The grass is maintained in the greenhouse to provide material year-round.

For callus induction, the grass is clipped and the leaves removed. The stolons are cut into sections containing a node with at least an inch of internode on each side on the node. The sections are placed into beakers containing 50/50 bleach/H₂O solution with a few drops of liquid detergent which act as a wetting agent.² The sections are allowed to soak for 40 to 50 minutes, and are then rinsed three times with sterile distilled water. The ends of the sections are aseptically removed and the nodes cut in half. The sections are then placed on nutrient media.

Several types of media and media sequences are being evaluated. Combinations of basal nutrient solutions, carbohydrate concentrations, and hormone concentrations, as well as specific hormone combinations, have been tested. Observations are made on the quantity and quality of callus formed and the callus regeneration potential.

RESULTS AND DISCUSSION

Four varieties of bermudagrass have been tested: 'Coastal', 'Grazer', 'Tifton 292', and 'OSU 6-7'. All have responded to culture conditions and formed callus. The media is now being modified to optimize callus growth for each variety. The optimal medium for Coastal and Grazer appears to be Murashige and Skoog basal nutrients with a low level of 2,4-dichlorophenoxy acetic acid and a relatively high sucrose concentration. Grazer proved the most responsive, producing callus within 2 days after sterilization and growing most rapidly. Four other varieties, 'Alicia', 'Brazos', 'Tifton 78', and 'W-26', are currently being evaluated for callus production.

Callus from all varieties is being tested for regeneration ability. Embryoids, buds, and small plantlets have been observed in callus from Grazer, Tifton 292, and OSU 6-7. Work is being continued to obtain and optimize the regeneration response of all the varieties, so that a high frequency of regeneration can be achieved. Regenerated plants will be vegetatively propagated.

One characteristic to be evaluated in the regenerated bermudagrass is resistance to Helminthosporium cynodontis. In cooperation with Dr. D. Groth at the Rice Research Station, initial work has begun on isolation of the organism, optimal growth conditions, and toxin production. Bermudagrass was collected from plots at the Hill Farm Research Station in December 1985. The bermudagrass harvested showed symptoms characteristic of Helminthosporium cynodontis infection. The tissue was brought to the Rice Research Station, cut into small sections, and surfaced sterilized in 95% ethanol for approximately 10 minutes. The sections were placed on potato-dextrose-agar (PDA) medium. Within a week, growth was observed on all sections. After 2 weeks, for all sections without bacterial growth, small sections of fungus were removed and placed on fresh medium. The cultures were allowed to grow for several days in an incubator and then placed in a refrigerator for long-term storage.

Another characteristic to be evaluated in bermudagrass is resistance to Spodoptera frugiperda, fall armyworm (FAW). In cooperation with Dr. S.S. Quisenberry of the Entomology Department, LSU Baton Rouge Campus, techniques are being established to obtain sterile FAW and perform feeding trials with callus developed from different varieties of bermudagrass. Success was obtained with egg sterilization and larval introduction to callus cultures. Tests are currently being performed to verify that normal development of FAW occurs on a diet of callus tissue.

ALFALFA IMPROVEMENT THROUGH TISSUE CULTURE

(A Preliminary Report)

S.S. Croughan

INTRODUCTION

Forage crops are grown throughout Louisiana for animal grazing and hay production. It is estimated that 12,000 to 15,000 acres of alfalfa are grown for hay. Most alfalfa hay, however, must be brought into the state. Better varieties, as well as improved management practices, are needed to increase the quality and quantity of alfalfa hay in the state. New varieties which are better adapted to Louisiana must be developed to withstand environmental (e.g., flooding) as well as biological problems (e.g., diseases and insects).

Through the use of tissue culture methods, new sources of germplasm can be developed for incorporation into alfalfa breeding programs. Variation in many traits has been developed through either selection at the cellular level or somaclonal variation observed in regenerated plants. The techniques for alfalfa cell culture were first developed in the 1970's. Callus can be initiated from many plant parts, and plants have been regenerated from callus, cell suspensions, and protoplasts. Much variation, however, is found in the response of different varieties to tissue culture manipulation. Refinements in the culture conditions, particularly the nutrient medium, are usually necessary to obtain optimal callus production and plant regeneration for each variety.

The objectives of this project are to optimize the culture conditions for southern alfalfa varieties and to evaluate regenerated plants for improved characteristics.

MATERIALS AND METHODS

At least 200 seeds from each of 18 varieties of alfalfa were surfaced sterilized in a bleach solution (50/50 bleach/H₂O for 90 min) and then rinsed in sterile water. Ten seeds were placed in each sterile glass petri dish, containing filter paper saturated with 0.01 M CaSO₄. After 7 days, cotyledons were aseptically removed and placed on a agar-solidified nutrient media. Two established media sequences were evaluated. From each seedling one cotyledon was placed on medium A and the other cotyledon on medium SA (Table 1). After approximately 4 weeks, the cotyledons were scored for the amount of callus formation. The callus was carefully removed from the cotyledons and transferred to fresh nutrient media. After 4 weeks, the callus was transferred to regeneration media. The callus which was initiated and grown on medium A was transferred to medium AR. The callus initiated and grown on medium SA was transferred to medium SR1 and after 4 to 5 days transferred to medium SR2 (Table 1).

Table 1. Media used for alfalfa callus induction and plant regeneration.
Rice Research Station, Crowley, LA. 1985.

Code	A	SA	AR	SR1	SR2	AW	SW
Basal nutrient solution ^{1/}	Blaydes	S&H	Blaydes	S&H	S&H	Blaydes	S&H
Sucrose concentration (%)	3	3	3	3	3	1	1
Hormones ^{2/} (mg/l):							
2,4-D	2.0	-	-	11.1	-	-	-
NAA	2.0	4.6	-	-	-	-	-
KIN	2.0	2.0	-	1.0	-	-	-
Misc. (g/l):							
(NH ₄) ₂ SO ₄	-	-	-	-	1.65	-	1.65
Yeast extract	-	-	2.0	-	-	-	-
Inositol	-	-	0.102	-	-	-	-

^{1/} Blaydes: see Blaydes, D.F. 1966. Interaction of kinetic and various inhibitors in the growth of soybean tissue. *Physiologia Plantarum* 19:746-753.

S&H: see Schenk, R.U. and A.C. Hildebrandt. 1972. Medium and techniques for induction and growth of monocotyledonous and dicotyledonous plant cell cultures. *Can. J. Bot.* 50:199-204.

^{2/} 2,4-D: 2,4-dichlorophenoxy acetic acid.

NAA: 1-naphthalene acetic acid.

KIN: kinetin (6-furfurylamino purine).

Cultures were checked every few days for regeneration and transferred to fresh nutrient media every 4 weeks. Plantlets which formed on medium AR were transferred to medium AW, and plantlets which formed on medium SR2 were transferred to medium SW. Once plantlets established a good root system, they were transferred to a pot and gradually acclimated to greenhouse conditions.

RESULTS AND DISCUSSION

The results obtained in the initial screening of 18 alfalfa varieties are shown in Table 2. All varieties formed callus on both media A and SA, however, the rates of callus formation were consistently better on medium SA. The lowest rate (67%) was with variety 'Vanguard' on medium A. The percent of cotyledons forming callus on medium SA was >91% for all varieties. Visually, the callus looked healthier on medium SA.

The number of cultures regenerating was low for all varieties, however, the cultures which did regenerate produced lots of plants. Embryoids and plantlets were obtained for all except two varieties. Previous researchers have hypothesized that the ability to regenerate in alfalfa is related to the germplasm background of the variety. We were able to regenerate varieties previously listed as poor or non-regenerator types. The previous workers only screened 20 to 25 seeds of each variety, while this study used at least 200 seeds of each variety. Because of the heterozygous character of alfalfa seed within a variety and the low rates of regeneration obtained here and by previous workers, it appears important to screen a large number of seeds. For the varieties in which no regeneration was obtained or in which no embryoids developed into plants, additional seeds are being screened for regeneration. The rates of regeneration were approximately the same on both types of media sequences, with neither showing a definite advantage over the other. A clear visual difference was observed, however, in the quality of embryoids and plantlets obtained with media sequence SR1/SR2/SW producing better regeneration. This is partly related to the better callus obtained on medium SA.

Work is continuing on optimizing the rates of regeneration for specific varieties which are recommended for Louisiana. Over 500 plants have been regenerated so far and are being evaluated for phenotypic traits. The plants will be allowed to flower, hand pollinated, and seed collected. The seeds will be germinated in the greenhouse and then transplanted to the field for further evaluation.

Table 2. Results of alfalfa callus induction and regeneration. Rice Research Station, Crowley, LA. 1985.

Variety	% Cotyledons forming callus		% Cultures regenerating	
	Media		Media	
	A	SA	AR/AW	SR1/SR2/SW
Apollo	89	96	4	9
ARC	84	97	0	0
Cal West 475	77	97	2	1
Cal West 481	89	99	2	5
Cimarron	88	96	4	2
Classic	90	98	9	5
Defender	89	94	6	7
Florida 77	77	99	3	1
Hi Phy	85	95	4	7
Kanza	78	97	0	0
Pioneer 521	88	97	10	5
Pioneer 532	90	95	0	2
Raidor	80	97	0	11
Shenandoah	82	94	4	2
Southern Special	95	99	5	3
Vancor	76	94	2	3
Vanguard	67	92	0	8
WL 318	93	99	0	7

BEEF CATTLE NUTRITION RESEARCH

INFLUENCE OF FEEDLOT SURFACE AND SHADE ON PERFORMANCE OF STEERS FED HIGH FORAGE DIETS

(A Progress Report)

T.W. White and F.G. Hembry

INTRODUCTION

Gains by steers grazing summer forages have not been effected by shade at the Rice Research Station. Gains on pasture was significantly lower than when green chopped forage was fed in shaded concrete pens. Likewise, steers fed on 80% hay ration gained more rapidly in shaded concrete pens than when fed in dirt lots with shade. This experiment was designed to study the influence of feedlot conditions and shade on performance of steers fed green chopped forage and a 80% hay ration.

MATERIALS AND METHODS

Seventy-two Hereford x Angus crossed steers averaging 473 pounds were blocked by weight into nine groups. One steer from each weight group was randomly assigned to each of eight treatments. The eight treatments were grazing, green chopped forage fed in partially covered concrete pens or dirt lot with shade, 80% hay ration fed in partially covered concrete pens, concrete pen with no shade, dirt pen with shade near the feeder, dirt pen with shade removed from the feeder and dirt pen without shade. The 80% hay ration also contained 4% corn, 3% cottonseed meal, 10% molasses, 2% urea, .5% trace mineral salt, .5% dicalcium phosphate and vitamin A. This ration had been shown previously to provide performance similar to summer pasture. The grazed grass, green chopped forage and hay was predominately dallisgrass. The grass was fertilized with 50-100-100 (N-P₂O₅-K₂O) in the spring and 150 pounds of nitrogen per acre in three applications throughout the summer. The 80% hay ration and green chopped forage was fed free-choice with the green chop cut and fed each morning. A mixture of trace mineral salt and dicalcium phosphate was provided for the pasture and green chopped forage treatments. Shade was provided in the dirt lots by a 18 x 22 ft shed.

This experiment was initiated in late April and terminated after 112 days. All weights were taken after a 16-hr. shrink without feed or water.

RESULTS AND DISCUSSION

The influence of feedlot surface and shade on average daily gain of steers consuming high forage diets is shown in Table 1. Steers on pasture gained faster ($P < .05$) than those on other treatments except 80% hay ration fed in partially covered concrete pens. These steers gained well throughout the grazing period and more than in previous years on this pasture. This may be partially explained by the fact that dallisgrass almost completely took over these pastures from high concentrations of Coastal bermudagrass in previous

years and dallisgrass has shown promise for this area in other experiments. Steers fed green chopped forage in partially covered concrete pens did not gain as well as steers on pasture possibly due to less selectivity but did gain faster ($P<.05$) than those fed in a dirt lot with shade even though the latter consumed more forage. Some difference was expected between these two treatments but the magnitude of the difference was surprising, particularly when intake is considered. The dirt lot was occasionally muddy but not to an extent that would explain the difference in gains.

Intake of the 80% hay ration was similar for all treatments, however, gains were influenced by treatments. Gains were similar when steers were fed on concrete or dirt with no shade or dirt with the feeder near the shade and less ($P<.05$) than when steers were fed in partially covered concrete pens.

SUMMARY

Seventy-two Hereford x Angus crossed steers were blocked by weight and assigned to eight treatments during a 112-day experiment to investigate the influence of feedlot surface and shade on performance of steers consuming high forage diets. The treatments were grazing, green chopped forage fed in partially covered concrete pens or dirt lots with shade, 80% hay ration fed in partially covered concrete pens, concrete pen with no shade, dirt pen with shade near the feeder, dirt pen with shade removed from feeder and dirt lot without shade. The forage was predominately dallisgrass. Steers fed green chopped forage in partially covered concrete pens gained ($P<.05$) more than those in the dirt lot even though the latter consumed more dry matter and both groups gained less ($P<.05$) than those that grazed. Steers fed the 80% hay ration consumed similar amounts of feed but did not gain similarly. Steers fed 80% hay ration on concrete or dirt with no shade gained less ($P<.05$) than those fed in partially covered concrete pens. In general, steers in dirt lots gained less than those on concrete. Shade did not appear to consistently influence performance.

Table 1. Influence of feedlot surface and shade on performance of steers consuming high forage diets. Rice Research Station, Crowley, LA. 1985.

Treatment	Average daily gain, lb	Dry matter intake, lb
Graze	1.10 ^d	
Green chop-concrete pen ^a	.78 ^{ef}	15.1
Green chop-dirt lot with shade	.30 ^h	18.4
80% hay ration-concrete pens ^a	.98 ^{de}	17.1
80% hay ration-concrete pen-no shade	.59 ^{fg}	16.9
80% hay ration-dirt lot with shade ^b	.62 ^{fg}	17.2
80% hay ration-dirt lot-with shade ^c	.78 ^{ef}	17.4
80% hay ration-dirt lot-no shade	.54 ^g	16.8

^a Partially covered concrete pens.

^b Shade near self-feeder.

^c Shade removed from self-feeder.

^{defgh} Means in the same column bearing different superscripts differ ($P<.05$).

COMPARISON BETWEEN MILLED RICE AND CORN IN FINISHING STEER RATIONS

(A Progress Report)

T.W. White and F.G. Hembry

INTRODUCTION

There is very little information on the value of rice as a feed grain for beef cattle. For many years very little rice was available for livestock feed, therefore, data was not generated. Recent changes in the market and high corn prices have resulted in interest in feeding rice. The present experiment was conducted to determine the value and level of milled rice that could be fed to finishing beef steers.

MATERIALS AND METHODS

Sixty Hereford-Angus crossed steers were blocked by weight into five weight groups and one steer from each group randomly assigned to each of five rations shown in Table 1 in each of two years. The steers averaged 572 lb in 1983 and 579 lb in 1984. Three pens of four steers were fed each ration. There was a heavy-, medium- and lightweight pen of steers for a total of 12 steers per treatment per year.

The steers were treated for internal parasites and implanted with zeranol prior to beginning the experiment. The steers were fed free-choice in partially covered concrete pens. All weights were taken after a 15-hour period without feed or water.

RESULTS AND DISCUSSION

The chemical composition of corn and milled rice on a dry matter basis is shown in Table 2. Corn was only slightly higher in crude protein than milled rice. The bran was removed from the rice in the milling process, therefore, it was lower in ether extract, crude fiber and ash than corn and higher in nitrogen-free extract. For all practical purposes, the composition is so similar that experimental rations were identical except for the level of corn and rice. The chemical composition of the ratios are presented on a dry matter basis in Table 3.

The performance of steers fed rations with various proportions of corn and milled rice is shown in Table 4. There was no significant difference in average daily gain nor any carcass characteristics. Feed intake was slightly lower when 50 or 100% of the grain was milled rice than when other combinations of corn and rice were fed. However, feed efficiency was very similar for all except the 100% rice grain ration which was slightly more efficient.

The average carcass grade was just slightly below choice with 57.5% of the carcasses grading choice or prime.

It appears that ground milled rice may be substituted for ground shelled corn on an equal basis without adversely influencing gains.

SUMMARY

Sixty Hereford-Angus steers were blocked by weight and randomly assigned to five finishing rations in each of two years. The basal ration contained 20% roughage and 62.5% corn, 10% molasses, 5% cottonseed meal, 1% urea, 1.5% minerals and vitamin A. Milled rice was substituted for 0, 25, 50, 75 and 100% of the corn in the five rations. The chemical composition of the corn and milled rice was very similar. There was no significant difference in average daily gain, feed intake or carcass characteristics due to the ration.

Table 1. Rations containing various proportions of milled rice and corn. Rice Research Station, Crowley, LA. 1984-1985.

Item	Corn and rice as a percentage of the total grain				
	100% corn	75% corn 25% rice	50% corn 50% rice	25% corn 75% rice	100% rice
	-----%-----				
Hay	20.0	20.0	20.0	20.0	20.0
Milled rice	0.0	15.6	31.2	46.9	62.5
Corn	62.5	46.9	31.2	15.6	0.0
Molasses	10.0	10.0	10.0	10.0	10.0
Cottonseed meal	5.0	5.0	5.0	5.0	5.0
Urea	1.0	1.0	1.0	1.0	1.0
Dicalcium phosphate	1.0	1.0	1.0	1.0	1.0
Salt, trace mineral	0.5	0.5	0.5	0.5	0.5
Vitamin A, IU/lb	1000	1000	1000	1000	1000

Table 2. Dry matter chemical composition of corn and milled rice samples. Rice Research Station, Crowley, LA. 1984-1985.

Item	Corn	Rice
Crude protein	11.5	11.0
Ether extract	3.3	1.4
Crude fiber	2.8	.5
Nitrogen-free extract	80.4	86.3
Ash	2.0	.8

Table 3. Chemical composition of dry rations containing various levels of corn and milled rice. Rice Research Station, Crowley, LA. 1984-1985.

Item	Corn and Rice as a percentage of the total grain				
	100% corn	75% corn 25% rice	50% corn 50% rice	25% corn 75% rice	100% rice
Crude protein	15.0	14.3	14.2	14.2	14.4
Ether extract	3.0	3.5	3.1	2.0	1.8
Crude fiber	10.2	9.8	9.4	10.4	9.2
Nitrogen-free extract	6.8	5.8	5.7	5.5	5.4
Ash	65.0	66.6	67.6	67.9	69.2

Table 4. Performance of steers fed rations with various proportions of corn and milled rice. Rice Research Station, Crowley, LA. 1984-1985.

Item	Corn and Rice as a percentage of the total grain				
	100% corn	75% corn 25% rice	50% corn 50% rice	25% corn 75% rice	100% rice
No. steers	24	24	24	24	24
Days on feed	133	133	133	133	133
Initial weight, lb	576	576	576	576	576
Daily intake, lb ^a	27.3	27.6	25.9	27.3	25.5
Daily gain, lb	2.66	2.72	2.46	2.69	2.64
Feed to gain ratio	10.3	10.1	10.5	10.1	9.7
Carcass weight, lb	545	550	529	538	537
Carcass grade ^b	11.6	11.7	11.3	11.4	11.2
Marbling ^c	10.5	10.9	9.9	10.2	10.0
Ribeye area, in ²	10.3	10.4	10.3	10.4	10.4
Fat thickness, in	.43	.44	.36	.44	.46
Kidney, heart and pelvic fat, %	2.1	2.2	2.2	1.9	2.1

^a Air dry feed intake

^b Carcass grade: 10=average good; 11=high good; 12=low choice

^c Marbling score: 10=small minus; 11=small

INTERNATIONAL RICE TRAINING PROGRAM

(A Progress Report)

Maurice F. Miller

The Louisiana State University Rice Research Station has cooperated for a number of years with the Foreign Training Division of the International Agricultural Development Service by providing informative training programs for international leaders.

Data regarding the classification of visitors according to countries are presented in Table 1. A total of 76 participants representing 26 countries received training at the Rice Research Station in 1985. The number of participants decreased from 99 in 1984 to 76 in 1985. Brazil, for two consecutive years, has provided the largest number of visitors.

Table 1. Number of participants trained according to country. Rice Research Station, Crowley, LA. 1985.

Country	No. participants
Australia	1
Brazil	11
Burma	2
China (PRC)	1
Colombia	2
Costa Rica	1
Egypt	2
Germany (West)	6
Guyana	6
Honduras	1
India	7
Indonesia	1
Iraq	3
Ireland	1
Japan	7
Liberia	5
Mali	1
Mexico	1
Nigeria	1
Nepal	2
Netherlands	2
Pakistan	1
Senegal	2
Sierra Leone	6
Thailand	2
Uruguay	1
Total	76

Table 2 presents information regarding the number of participants according to sponsoring organizations. The majority were sponsored by USAID.

Subject matter interest of the participants varied from general rice production practices to specific interests concerning plant breeding, genetics, tissue culture, water management, and disease and insect control. Of primary interest to all were the factors of production, processing, and marketing that have attributed to the present level of efficiency of the American farmer.

Table 2. Number of visitors according to sponsoring organizations. Rice Research Station, Crowley, LA. 1985.

Sponsoring organization	Number sponsored
American Rice Council	6
Cafesa	1
Cameco	2
CIA Agricola Extremo	5
CIAT	2
CIMMYT	1
Consolidated Fert. Ltd.	1
Coop. Arrozeria Extremo	2
DMCC	1
Egypt - Calif. Rice Proj.	2
FAO	1
Fert. Corp. of India	1
German Fert.	2
Government (other than US)	9
Grassland Fert. Ltd.	1
IFDC	3
Indian Explosives Ltd.	1
Indumec Industrial Machines	1
Institute of Agricultural Machinery	1
Louisiana State University	1
Private	5
Siam Grain Co.	1
UNDP	2
USAID	18
USIA	1
UUF Fertilizer Co.	2
Yanmar Agricultural Equipment Co. Ltd.	3
Total	76

ECONOMICS OF CROP AND LIVESTOCK
ENTERPRISES AND ENTERPRISE COMBINATIONS
IN LOUISIANA RICE AREAS ^{1/}

(A Progress Report)

T. P. Zacharias and B. E. McManus

INTRODUCTION

The purpose of this report is to summarize the results of a recent farm survey and to provide projected cost and return estimates for rice, soybeans, and milo enterprises in southwest Louisiana for 1986. Projected cost and return estimates for rice production in northeast Louisiana are also presented.

MATERIALS AND METHODS

A survey of 1984 farmer production practices was conducted during January and February of 1985 in the southwest Louisiana rice area. A stratified random sampling procedure was used to determine the farmers who would be interviewed. Specific questions on the survey included land use patterns, tenure arrangements, sequence of production operations, and application rates for variable inputs. A summarization of selected survey results is presented in Tables 1 to 6.

Enterprise costs and returns were projected using the survey data noted above. An informal survey of input suppliers, machinery dealers, and aerial applicators was also conducted in order to obtain input price data used in the construction of the enterprise budgets. Due to the detailed nature of the cost computations, a computerized budget generator procedure was utilized. The budget generator consists of a computer program which specifies a system of computational procedures for calculating costs and returns. A copy of the computer program used in this report can be obtained from the Division of Economics and Resource Development, Louisiana Cooperative Extension Service, or The Department of Agricultural Economics and Agribusiness, Louisiana Agricultural Experiment Station upon request.

RESULTS AND DISCUSSION

Table 1 provides a summary of the land use pattern in the region. The majority of crop acreage is in soybeans and is operated under some form of crop-share tenancy. The predominant output share for both landlords and waterlords is one-fifth of the crop with less than 5% of them operated on a cash rent system. Information on machinery complements is found in Table 3. On average, farmers operate four tractors with the larger farms operating more than one combine. Average age for tractors and combines is 8.5 and 7.4 years,

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

Table 1. Acreage characteristics by tenure and enterprise, southwest Louisiana, 1984.

Item	Number of farms reporting	Average	Maximum	Minimum
Total acres	50	877	2228	102
Acres owned	29	212	2228	5
Acres rented	49	770	2000	44
Rice acres	49	325	1335	35
Acres owned	16	162	878	5
Acres rented	48	278	1200	35
Acres 2nd crop cut	21	181	400	20
Soybean acres	47	519	1270	15
Acres owned	18	164	1200	18
Acres rented	46	466	1270	15
Other crop acres	3	176	197	150
Pasture acres	13	150	650	12
Non crop acres	4	264	1020	5

Source: 1985 Survey.

Table 2. Tenure and lease information, rice crop, southwest Louisiana, 1984.

Item	Number of farms reporting	Percent of farms reporting	Tenure class by acreage	Percent of acreage by tenure class
Farms by tenure				
Total rice acres	49	100.00	15933	100.00
Owned only	1	2.04	878	5.51
Rented only	33	67.35	7960	49.96
Owned and rented	15	30.61	7095	44.53
Leases by rental arrangement				
Cash rent	3	4.62	435	3.44
Crop share				
Landlord only (1/6)	4	6.15	1342	10.61
Landlord only (1/5)	8	12.31	920	7.27
Landlord only (1/4)	6	9.23	797	6.30
Land (1/6) Water (1/6)	3	3.08	342	2.70
Land (1/6) Water (1/5)	1	1.54	34	0.27
Land (1/5) Water (1/5)	30	46.15	5570	44.02
Land (1/4) Water (1/4)	2	3.08	500	3.95
Land and Water 30%	1	1.54	49	0.39
Land and Water 45%	7	10.77	2511	19.85
Land and Water 60%	1	1.54	153	1.21

Source: 1985 Survey.

Table 3. Machinery characteristics by power unit, southwest Louisiana, 1984.

Machinery	Pickups	Trucks	Combines	Tractors
Number per farm	1.09	1.68	1.6	4.08
Crop acres/power unit	754	436	504	210
Average age	4.64	14.03	7.41	8.45
Acquisition cost per power unit	7891	6033	48312	22366
Pickup miles per farm	14900			

Table 5. Seeding, fertilization, and chemical application rates for rice, southwest Louisiana, 1984.

	Water-planted		Drill-planted	
	% Farms reporting	Average per unit	% Farms reporting	Average per unit
Seeding rate per acre	98	1.38 cwt	100	1.33 cwt
Nitrogen applied per acre	98	94 lb	100	97 lb
Phosphate applied per acre	90	47 lb	95	54 lb
Potassium applied per acre	90	43 lb	95	52 lb
2nd cutting nitrogen	10	45 lb	14	46 lb
Stam applied per acre	71	3.1 qt	91	3.6 qt
Ordram 10G applied per acre	57	30.7 lb	36	34.0 lb
2,4-Dacamine applied per acre	29	1.1 lb	18	1.2 qt
Furadan 3G applied per acre	24	21.0 lb	32	15.5 lb

Table 6. Irrigation systems, southwest Louisiana, 1984.

	<u>Distribution of water source (%)</u>			
	<u>Wells</u>		<u>Surface</u>	<u>Canal</u>
	74.1		22.4	3.5
	<u>Distribution of wells by fuel type (%)</u>			
	<u>Butane</u>	<u>Diesel</u>	<u>Electricity</u>	<u>Natural Gas</u>
	7.0	20.0	14.0	59.0
<u>Related Characteristics:</u>				
Gallons per minute	----	2500	2075	2936
Motor age	20.0	13.8	9.8	12.7
Pump age	20.0	14.5	16.5	16.5
Estimated fuel costs (\$/A)	27.00	71.57	38.00	35.90

Table 4. Rice variety information, southwest Louisiana, 1984.

Variety	Obs ^{a/}	Acres	Second crop harvested			Water-planted			Dry-planted		
			Yld/A (cwt)	Obs	Acres	Yld/A (cwt)	Obs	Acres	Yld/A (cwt)	Obs	Acres
Bellevue	5	159	37.51	0	0		3	57	37.97	2	102
Labelle	48	5896	38.15	18	1369	9.55	29	3980	36.26	19	1916
Lebonnet	20	1369	41.04	7	471	9.46	16	1182	40.58	4	187
Leah	1	100	51.84	0	0		1	100	51.84	0	0
Lemont	4	186	42.04	0	0		4	186	42.04	0	0
Mars	52	5490	45.04	14	1013	10.22	35	3969	44.20	17	1521
Saturn	9	841	37.62	0	0		7	707	39.06	2	134
Other varieties:	6	1180	43.66	3	250	8.10	3	635	44.43	3	545
Totals:	145	15221	41.42	42	3103	9.64	98	10816	40.56	47	4405
											43.51

Source: 1985 Survey.

^{a/} For this section of the questionnaire, the observations represent farmers' response by individual fields.

respectively. The results in Table 4 represent an attempt to determine the acreage distribution of the various rice varieties typically planted in southwest Louisiana. 'Labelle', 'Lebonnet', and 'Mars' were the leading varieties for 1984. Slightly higher yields were associated with dry planting and the average second crop yield was 9.64 cwt/A. Table 5 provides a breakdown on the per acre variable input rates for water- and drill-planted rice. Under water-planting technology, less fertilizer was applied on water-planted rice acreage along with reduced rates on herbicide products. Lastly, Table 6 presents the characteristics of the irrigation systems commonly encountered in the region.

The production practice data obtained from the survey was then used to construct enterprise budgets for rice, soybeans, and milo for the southwest Louisiana rice area. Rice enterprise budgets for northeast Louisiana farming were also developed using somewhat older survey data for that region. Total specified production costs (excluding overhead) for an owner-operator situation in southwest Louisiana were \$377.73 and \$352.99 per acre for water- and dry-planted rice, respectively. Total per acre costs for a tenant situation were estimated to be approximately \$302.09 and \$274.37 for water- and dry-planted rice, respectively. Total per acre production costs for soybeans and milo were estimated to be approximately \$160.00 and \$130.04, respectively. The reader should be cautioned that production cost estimates for milo are based on limited survey data and should be considered preliminary at this time. Tables 7 and 8 provide a summary of the production cost estimates and associated breakeven levels for the rice, soybean, and milo enterprises of southwest Louisiana.

For rice production in northeast Louisiana total specified costs for an owner-operator situation were \$344.18 and \$337.30 per acre for water- and dry-planted, respectively. Total specified production costs for tenant-operators were estimated to be \$221.84 and \$218.76 per acre for water- and dry-planted rice, respectively. A summary of these cost estimates for the various tenure situations along with a series of breakeven selling prices is found in Table 9.

Table 7. Breakeven selling prices for rice for selected yield levels, southwest Louisiana, 1986.^{a/}

Crop description	Total costs	Total variable costs	Base yield level	Unit	Yield level				Price or avg. cost ---dollars/cwt---
					-20%	-10%	Base	+10%	
----dollars/A----									
Prices required to recover total specified costs									
Rice, water-planted, owner	377.73	N/A	41.45 ^{b/}	cwt	11.02	9.96	9.11	8.42	7.84
Rice, water-planted, tenant	302.09	N/A	24.87 ^{c/}	cwt	14.18	13.33	12.15	11.18	10.37
Rice, drill-planted, owner	352.99	N/A	43.66 ^{b/}	cwt	9.73	8.82	8.08	7.49	6.99
Rice, drill-planted, tenant	274.37	N/A	26.20 ^{c/}	cwt	12.72	11.47	10.47	9.66	8.98
Rice, second cutting	100.51	N/A	9.64 ^{b/}	cwt	12.81	11.48	10.43	9.56	8.84
Prices required to recover variable costs									
Rice, water-planted, owner	N/A	306.18	41.45 ^{b/}	cwt	8.86	8.04	7.39	6.85	6.41
Rice, water-planted, tenant	N/A	256.63	24.87 ^{c/}	cwt	12.52	11.30	10.32	9.52	8.85
Rice, drill-planted, owner	N/A	281.62	43.66 ^{b/}	cwt	7.69	7.00	6.45	6.00	5.63
Rice, drill-planted, tenant	N/A	229.08	26.20 ^{c/}	cwt	10.55	9.55	8.74	8.09	7.54
Rice, second cutting	N/A	70.78	9.64 ^{b/}	cwt	8.95	8.06	7.34	6.76	6.27

N/A Not applicable.

^{a/} Rental arrangement for rice were 1/5 cropshare for land and 1/5 cropshare for water with both landlord and waterlord paying 1/5 of fertilizer and chemicals.

^{b/} Does not include land costs, however, land costs are accounted for in the budgets.

^{c/} Tenant share of yield.

Table 8. Break-even selling price for soybeans and milo for selected yield levels, southwest Louisiana, 1986.^{a/}

Crop description	Total costs	Total variable costs	Base yield level	Yield level					
				-20%	-10%	Base	+10%	+20%	
---dollars/A----				Price or avg. cost -----dollars/cwt-----					
Prices required to recover total specified costs ^{b/}									
Soybeans, 6-row equip., owner	158.34	N/A	24.50 ^{b/}	bu	7.99	7.14	6.46	5.91	5.44
Soybeans, 6-row equip., tenant	157.06	N/A	19.60 ^{c/}	bu	9.93	8.86	8.01	7.32	6.74
Soybeans, drill-planted, owner	160.26	N/A	27.00 ^{b/}	bu	7.33	6.56	5.94	5.43	5.00
Soybeans, drill-planted, tenant	158.59	N/A	21.60 ^{c/}	bu	9.09	8.12	7.34	6.71	6.18
Milo, drill-planted, owner	130.04	N/A	44.43 ^{b/}	cwt	3.57	3.22	2.93	2.69	2.50
Milo, drill-planted, tenant	130.04	N/A	35.54 ^{c/}	cwt	4.49	4.03	3.66	3.36	3.11
Prices required to recover variable costs									
Soybeans, 6-row equip., owner	N/A	120.64	24.50 ^{b/}	bu	6.07	5.43	4.92	4.51	4.16
Soybeans, 6-row equip., tenant	N/A	123.32	19.60 ^{c/}	bu	7.78	6.95	6.29	5.75	5.30
Soybeans, drill-planted, owner	N/A	128.64	27.00 ^{b/}	bu	5.87	5.25	4.76	4.36	4.03
Soybeans, drill-planted, tenant	N/A	126.98	21.60 ^{c/}	bu	7.26	6.49	5.88	5.38	4.96
Milo, drill-planted, owner	N/A	103.29	44.43 ^{b/}	cwt	2.82	2.54	2.34	2.15	2.00
Milo, drill-planted, tenant	N/A	103.29	35.54 ^{c/}	cwt	3.54	3.19	2.91	2.67	2.48

N/A Not applicable.

a/ Rental arrangements for soybeans and milo were 1/5 cropshare with no cost sharing on the part of the landlord.

b/ Does not include land charge.

c/ Tenant share of yield.

Table 9. Breakeven selling prices^{a/} for rice for selected yield levels, Mississippi Delta and Ouachita areas, Louisiana, 1986.

Crop description	Total specified costs	Total variable costs	Base yield level	Unit	Yield level				
					-20%	Base	+10% +20%		
Price or ave. cost -----dollars-----									
Prices required to recover total specified costs ^{b/}									
Rice, water-planted, owner	344.18	N/A	45.00 ^{b/}	cwt	9.19	8.33	7.65	7.09	6.62
Rice, water-planted, tenant	221.84	N/A	22.50 ^{c/}	cwt	11.95	10.79	9.86	9.10	8.47
Rice, dry-planted, owner	337.30	N/A	45.00 ^{b/}	cwt	8.99	8.16	7.50	6.95	6.50
Rice, dry-planted, tenant	218.76	N/A	22.50 ^{c/}	cwt	11.78	10.64	9.72	8.98	8.35
Prices required to recover variable costs									
Rice, water-planted, owner	N/A	285.09	45.00 ^{b/}	cwt	7.54	6.87	6.34	5.90	5.53
Rice, water-planted, tenant	N/A	176.88	22.50 ^{c/}	cwt	9.45	8.57	7.86	7.28	6.80
Rice, dry-planted, owner	N/A	275.43	45.00 ^{b/}	cwt	7.28	6.63	6.12	5.70	5.35
Rice, dry-planted, tenant	N/A	171.01	22.50 ^{c/}	cwt	9.13	8.28	7.60	7.05	6.58

N/A Not Applicable.

^{a/} Rental arrangement for rice was 1/4 cropshare for land and 1/4 cropshare for water with both landlord and waterlord paying 1/4 seed, fertilizer, and chemicals.

^{b/} Does not include land costs.

^{c/} Tenant share of yield at all yield levels.

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