PATHOLOGY RESEARCH

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Pathology research addresses the important diseases affecting sugarcane in Louisiana. The overall program goal is to minimize losses to diseases in a cost-effective manner. Projects receiving emphasis during 2008 included: evaluating brown rust management with fungicides; support of healthy seedcane programs to manage ratoon stunting disease (RSD), yellow leaf, and other systemic diseases; development of new pathogen detection methods; determining the molecular nature of resistance to leaf scald; screening for new sources of resistance to red rot; evaluating disease resistance in the variety selection program; and billet planting. Research results on billet planting are reported separately.

BROWN RUST

Four sugarcane field experiments were conducted during 2008 to evaluate the potential of fungicides to control brown rust, caused by *Puccinia melanocephala*. Unfortunately, multiple circumstances resulted in poor quality yield data being obtained from these experiments. Following a winter with several hard freezes and a cool spring, brown rust began late in the season and moved slowly and erratically through the sugarcane industry. One experiment was affected by the late, slow start of the epidemic and one was not completed because of a lack of disease progress. The harvest data obtained from three experiments was then negatively impacted by crop damage caused by two hurricanes. One experiment conducted in the southernmost portion of the industry developed rust early, but this field was in the direct path of hurricane Gustav and sustained extensive lodging and top breakage. Good fungicide efficacy results were obtained during the spring in this experiment. A strip trial with Headline fungicide in the southern part of the industry developed rust symptoms and treatments reduced symptom severity; however, harvest data was adversely affected by top breakage and lodging. The details of the experiments and results obtained are provided below.

A large experiment comparing 23 treatments (Table 1) consisting of multiple fungicides applied singly or in combinations and some with multiple rates was conducted at the LSU AgCenter Sugar Research Station at St. Gabriel to identify the best products and application rates for brown rust control. Fungicide treatments were applied to plantcane of LCP 85-384 in two row plots, 30 ft. in length, with four replications. All fungicide treatments were applied two times except for two treatments with one fungicide followed by another. Application dates were 20-21 May and 9-10 June. Brown rust lesions were evident on some older leaves, but a moderate rust epidemic did not develop on the younger leaves until mid-June about 1-2 weeks after the second application. Rust symptom severity was determined by image analysis using the fifth youngest fully emerged leaf, six leaves per plot, collected on 8 July (28-29 days after the second application). Most fungicide treatments reduced rust symptom severity, and differences in efficacy were detected among treatments (Table 1). The experiment was harvested on 8 December. No differences in cane tonnage or total sucrose per acre were detected comparing fungicide treatments to the non-treated control (Table 2).

Two experiments were conducted on commercial farms in plantcane of Ho 95-988. Fifteen treatments were applied (Table 3). Multiple fungicides were compared with variable numbers and times of application. One experiment was established in Iberia Parish and another in Terrebonne Parish. Brown rust began early in the experiment in Terrebonne Parish. Fungicide application dates were 1 April, 18 April, and 7 May. Treatments with two applications were applied on the first two dates, while the delayed application treatments were applied on the last two dates. The third fully emerged leaf was collected for image analysis (six leaves per plot) on 7 May at 19 days after the second application date. The third fully emerged leaf was collected on 27 May at 20 days after the third application date. All fungicide treatments reduced rust symptom severity, and differences were detected among treatments (Table 3). The experimental design with different numbers and timing of applications produced some interesting results. At the first assessment date (19 days after the second application date), two fungicides, Headline and BAS 556 01F, applied twice or only once with a delayed start (the second application of the delayed start being made the day of assessment) showed less control in the delayed start treatment. At the time of the second assessment (20 days after the third application date), delayed application treatments exhibited comparable control to the early two application treatment, in the case of Headline, and more control, in the case of BAS 556 01F. In comparison of two versus three application treatments, some control was still evident in the two application treatments 39 days after treatment, but a superior, high level of control was evident in the three application treatments. The experiment was harvested on 18 December, but no differences were detected in comparisons with the non-treated control (Table 4). No rust epidemic occurred in the Iberia Parish experiment, so the experiment was not taken to harvest.

Headline fungicide was applied at a rate of 9 oz/acre with a commercial five-row sprayer to create a strip trial in Ho 95-988 plantcane in St. Mary Parish in which brown rust symptoms were already evident. Four sets of rows were treated initially, four sets of rows were treated for the first time 3 weeks later, four sets of rows were treated at both application dates, and sets of rows were left untreated. Rust symptom severity was reduced by two fungicide applications (Table 5). At harvest, one entire row was weighed to estimate cane tonnage yield, and a 10 stalk sample was collected from each treatment replication for sucrose content analysis. However, no significant differences were detected among treatments for cane tonnage or total sucrose per acre yield.

Despite the lack of quality yield results, some efficacy comparisons were successful during the 2008 growing season. The results are similar to results from previous testing during 2006-2007. In general, strobilurin fungicides appear to be most effective, and combinations of a strobilurin with a triazole provided good control.

HEALTHY SEEDCANE PROGRAM SUPPORT AND DISEASE DETECTION METHODS

RSD testing was conducted by the Sugarcane Disease Detection Lab for the 12th year during 2008. RSD was monitored on farms, in the LSU AgCenter Variety Selection Program, in the American Sugar Cane League Variety Release Program, and in the Kleentek® and SugarTech® (Helena Chemical Co.) seedcane production systems (Table 6). A total of 1,660 samples were tested. No RSD was detected at any level of Kleentek production or in ASCL

Variety Release Program samples. Because of the hurricanes, little RSD testing was performed on commercial farms. RSD was not detected in the few fields tested.

The Sugarcane Disease Detection Lab also monitored for *Sugarcane yellow leaf virus* in the LSU AgCenter Variety Selection Program, the ASCL Variety Release Program, and SugarTech® and Kleentek® seedcane sources (Table 7). A total of 11,052 samples were tested. Commercial tissue culture seedcane sources were tested for the third season as part of the Louisiana Department of Agriculture and Forestry Seedcane Certification Program. No field failed to certify due to virus infection.

Four varieties were processed through the Local Quarantine to provide healthy material to establish Foundation Stock plants that will serve as the source for tissue culture seedcane production. A real-time, quantitative polymerase-chain-reaction assay for the leaf scald pathogen, *Xanthomonas albilineans,* was developed for use in disease monitoring and research.

MOLECULAR NATURE OF RESISTANCE TO LEAF SCALD

Research utilizing a proteomics approach to determine the molecular nature of resistance to leaf scald has been initiated. The proteins (gene products) produced by a leaf scald resistant variety, Ho 95-988, are being compared in inoculated and non-inoculated plants. Proteins that are differentially regulated following infection by *Xanthomonas albilineans* have been observed. These proteins will be identified and evaluated for an association with resistance to leaf scald. It should be possible to infer possible mechanisms of resistance, and molecular markers for resistance selection might be developed in the future.

EVALUATING RESISTANCE TO RED ROT

The basic germplasm collection utilized by the basic breeding program at the USDA-ARS Sugarcane Research Unit in Houma was screened for new sources of resistance to red rot, caused by *Colletotrichum falcatum,* in cooperation with Dr. Anna Hale. In addition, progeny from early generation crosses with basic parents were evaluated for resistance to study the inheritance of resistance. Four stalks per clone were inoculated in a central stalk internode with spores of the pathogen. Stalks were held to allow stalk rot to develop then split and evaluated for disease severity. Variation in red rot severity was detected among clones in both experiments, and new potential sources of resistance were identified. An analysis of the results of the inheritance study is not yet complete.

VARIETY SELECTION

Disease resistance levels were evaluated as a routine part of the Variety Selection Program. Inoculated tests were conducted to determine resistance levels in experimental varieties to smut (Table 8) and leaf scald (Table 9). Visual ratings were used to evaluate resistance to brown rust in out-field yield trial plots.

Table 1. Fungicide efficacy for reducing brown rust severity in sugarcane variety LCP85-384 plantcane in a field experiment at the LSU Sugar Research Station during 2008.

Treatment[y]	Rust symptom severity (%)
Non-treated control	5.20 a
Metconazole (Caramba 90 SL), 10 oz/A	4.51 ab
Metconazole (Caramba 90 SL), 14 oz/A	3.55 bcd
Pyraclostrobin (Headline), 9 oz/A	1.01 g
Pyraclostrobin (Headline), 12 oz/A	1.04 g
Pyraclostrobin, 6 oz/A + metconazole, 8 oz/A	0.94 g
Pyraclostrobin, 9 oz/A then metconazole, 14 oz/A	3.56 bcd
BAS 556 01F, 9 oz/A	0.85 g
BAS 556 01F, 12 oz/A	0.81 g
BAS 556 UUF, 12 oz/A	0.81 g
Trifloxystrobin + propiconazole (Stratego), 19 oz/A	2.89 def
JAU 6476 + trifloxystrobin, 12 oz/A + Induce, 0.125%	2.07 efg
USF 0729, 10 oz/A + Induce, 0.125%	1.58 fg
Propiconazole (Tilt), 8 oz/A	3.93 abcd
Azoxystrobin (Quadris), 6 oz/A	2.98 def
Azoxystrobin (Quadris), 9 oz/A	3.27 bcde
Azoxystrobin + propiconazole (Quilt), 14 oz/A	2.07 efg
Azoxystrobin, 9 oz/A then propiconazole, 6 oz/A	2.70 def
Flusilazole (Punch 3.3 EC), 4 oz/A + Induce, 0.125%	4.42 abc
Picoxystrobin (2.08 SC), 6 oz/A + Induce, 0.125%	3.46 bcde
Picoxystrobin (2.08 SC), 9 oz/A + Induce, 0.125%	3.70 bcd
Flusilazole, 3 oz/A + picoxystrobin, 6 oz/A + Induce, 0.125%	3.03 cde
Flutriafol (Topguard), 14 oz/A	3.15 bcde

All fungicide treatments applied two times except for the two treatments with one fungicide followed by another. Application dates were 20-21 May and 9-10 June. Rust symptom severity was determined by image analysis using the fifth youngest fully emerged leaf, six leaves per plot, collected on 8 July (28-29 days after the second application). Symptom severity means followed by the same letter were not significantly different (P=0.05).

Table 2. Effect of fungicide applications on plantcane yield of sugarcane variety LCP85-384 in a field experiment at the LSU Sugar Research Station during 2008.

Treatment[y]	Tons of cane/acre [z]	Sucrose/acre (lbs.) [z]
Non-treated control	27.3 bc	5969 ab
Metconazole (Caramba 90 SL), 10 oz/A	27.4 abc	6130 ab
Metconazole (Caramba 90 SL), 14 oz/A	28.1 abc	6178 ab
Pyraclostrobin (Headline), 9 oz/A	28.5 abc	6117 ab
Pyraclostrobin (Headline), 12 oz/A	30.4 abc	6665 ab
Pyraclostrobin, 6 oz/A + metconazole, 8 oz/A	31.5 abc	6892 a
Pyraclostrobin, 9 oz/A then metconazole, 14 oz/A	29.7 abc	6367 ab
BAS 556 01F, 9 oz/A	27.9 abc	6214 ab
BAS 556 01F, 12 oz/A	29.5 abc	6481 ab
BAS 556 UUF, 12 oz/A	29.1 abc	6276 ab
Trifloxystrobin + propiconazole (Stratego), 19 oz/A	27.0 bc	6007 ab
JAU 6476 + trifloxystrobin, 12 oz/A + Induce, 0.125%	31.9 abc	6943 a
USF 0729, 10 oz/A + Induce, 0.125%	27.6 abc	5755 b
Propiconazole (Tilt), 8 oz/A	29.5 abc	6448 ab
Azoxystrobin (Quadris), 6 oz/A	28.2 abc	6179 ab
Azoxystrobin (Quadris), 9 oz/A	28.1 abc	6143 ab
Azoxystrobin + propiconazole (Quilt), 14 oz/A	28.7 abc	6438 ab
Azoxystrobin, 9 oz/A then propiconazole, 6 oz/A	26.7 c	5947 ab
Flusilazole (Punch 3.3 EC), 4 oz/A + Induce, 0.125%	28.6 abc	5979 ab
Picoxystrobin (2.08 SC), 6 oz/A + Induce, 0.125%	26.7 c	5715 b
Picoxystrobin (2.08 SC), 9 oz/A + Induce, 0.125%	28.2 abc	6211 ab
Flusilazole, 3 oz/A + picoxystrobin, 6 oz/A + Induce, 0.125%	30.3 abc	6715 ab
Flutriafol (Topguard), 14 oz/A	28.6 abc	6279 ab

[y]All fungicide treatments applied two times except for the two treatments with one fungicide followed by another. Application dates were 20-21 May and 9-10 June.

[z] Means within a column followed by the same letter were not significantly different (P=0.05).

Table 3. Fungicide efficacy for reducing brown rust severity in plantcane of sugarcane variety

Ho 95-988 in a field experiment in Terrebonne Parish during 2008.

Treatment[y]	Rust (%) May 7[z]	Rust (%) May 27[z]
Non-treated control	24.9 a	13.9 a
Metconazole (Caramba 90 SL), 10 oz/A, two applications	14.8 b	12.7 ab
Pyraclostrobin (Headline), 9 oz/A, two applications	5.2 efg	9.4 bcde
Pyraclostrobin (Headline), 9 oz/A, three applications	3.8 fg	2.4 i
Pyraclostrobin (Headline), 9 oz/A, two applications, delayed start	10.6 c	6.1 efgh
Pyraclostrobin, 6 oz/A + metconazole, 8 oz/A, two applications	3.7 fg	10.1 bcd
Pyraclostrobin, 6 oz/A + metconazole, 8 oz/A, three applications	2.3 g	3.9 ghi
BAS 556 01F, 9 oz/A, two applications	4.7 efg	7.2 defg
BAS 556 01F, 9 oz/A, two applications, delayed start	12.1 bc	3.0 hi
Trifloxystrobin + propiconazole (Stratego), 19 oz/A, two applications	4.3 fg	7.7 cdef
JAU 6476 premix, 12 oz/A + Induce, 0.125%, two applications	5.0 efg	8.9 cdef
JAU 6476 premix, 12 oz/A + Induce, 0.125%, three applications	5.6 efg	5.5 fghi
Azoxystrobin (Quadris), 9 oz/A, two applications	9.8 cd	8.5 cdef
Azoxystrobin + propiconazole (Quilt), 14 oz/A, two applications	8.6 cde	11.3 abc
Azoxystrobin + propiconazole (Quilt), 14 oz/A, three applications	6.4 def	3.7 ghi

[y]Fungicide application dates were 1 April, 18 April, and 7 May. Two application treatments were applied on the first two dates, while the delayed application treatments were applied on the last two dates. The third fully emerged leaf was collected for image analysis (six leaves per plot) on 7 May at 19 days after the second application date. The third fully emerged leaf was collected on 27 May at 20 days after the third application date.

[z] Means within a column followed by the same letter were not significantly different (P=0.05).

Table 4. Effects of fungicide applications on plantcane yield of sugarcane variety Ho 95-988 in a field experiment in Terrebonne Parish during 2008.

Treatment[y]	Tons of cane/acre [z]	Sucrose/acre (lbs.) [z]
Non-treated control	46.4 ab	10002 ab
Metconazole (Caramba 90 SL), 10 oz/A, two applications	39.4 b	8315 b
Pyraclostrobin (Headline), 9 oz/A, two applications	51.2 a	9679 ab
Pyraclostrobin (Headline), 9 oz/A, three applications	45.1 ab	9803 ab
Pyraclostrobin (Headline), 9 oz/A, two applications, delayed start	53.9 a	11599 a
Pyraclostrobin, 6 oz/A + metconazole, 8 oz/A, two applications	44.6 ab	9610 ab
Pyraclostrobin, 6 oz/A + metconazole, 8 oz/A, three applications	47.4 ab	10124 ab
BAS 556 01F, 9 oz/A, two applications	39.9 b	8417 b
BAS 556 01F, 9 oz/A, two applications, delayed start	43.9 ab	9733 ab
Trifloxystrobin + propiconazole (Stratego), 19 oz/A, two applications	46.1 ab	10009 ab
JAU 6476 premix, 12 oz/A + Induce, 0.125%, two applications	43.3 ab	9539 ab
JAU 6476 premix, 12 oz/A + Induce, 0.125%, three applications	45.7 ab	9488 ab
Azoxystrobin (Quadris), 9 oz/A, two applications	38.1 b	8256 b
Azoxystrobin + propiconazole (Quilt), 14 oz/A, two applications	48.3 ab	10640 ab
Azoxystrobin + propiconazole (Quilt), 14 oz/A, three applications	43.3 ab	9538 ab

[y]Fungicide application dates were 1 April, 18 April, and 7 May. Two application treatments were applied on the first two dates, while the delayed application treatments were applied on the last two dates.

[z] Means within a column followed by the same letter were not significantly different (P=0.05).

Table 5. Effect of Headline fungicide treatments on brown rust severity and sugarcane yield in brown rust affected field of Ho 95-988 plantcane in an experiment in St. Mary Parish during 2008.

Fungicide treatment	Rust severity (%)[y]	Stalk weight (lbs.)	Sucrose/ton cane (lbs.)	Tons of cane/acre	Sucrose/acre (lbs.)
Non-treated control	13.1 a	1.89	232	32.7	7508
First Headline application	--	1.86	233	32.7	7641
Second Headline application	--	1.77	227	34.4	7801
Two Headline applications	2.4 b	1.77	231	33.7	7760

[y] Rust symptom severity was determined on 30 May by image analysis using the second fully emerged leaf (eight leaves per set of rows) for the non-treated control and the treatment receiving two fungicide applications. Means within a column followed by the same letter were not significantly different (P=0.05).

Table 6. Ratoon stunting disease testing summary for 2008.

Source	Location	No. of fields	No. of varieties	No. of samples
Louisiana growers	State-wide	15	9	367
Variety Release Program	1° & 2° stations	-	1	167
Helena SugarTech®	Foundation stock	5	9	71
Kleentek®	Foundation stock	-	32	117
Kleentek®	Other than foundation	28	8	362
Local Quarantine	LSUAC	-	10	54
Research	LSUAC	19	8	522
Totals		67	77	1660

Table 7. Sugarcane yellow leaf virus testing summary for 2008.

Source	Location	No. of fields	No. of varieties	No. of samples
LDAF	Seed Certification	204	-	7152
Syngenta	Houma	-	2	10
Helena SugarTech®	Foundation stock	5	9	83
Kleentek®	Foundation stock	-	45	335
Kleentek®	Other than foundation	82	-	2447
Local Quarantine	LSUAC	-	10	54
Research	LSUAC	64	8	971
Totals		355	-	11052

Table 8. Smut infection level and resistance ratings for experimental varieties determined from an inoculated test during 2008.

Variety	Infection (%)	Rating[x]	Variety	Infection (%)	Rating[x]
1965-357	14	4	2005-918	0	1
1973-351	35	7	2005-920	9	4
1979-1002	46	9	2005-923	12	4
1995-988	26	6	2005-931	4	3
1996-540	0	1	2005-937	0	1
1997-128	50	9	2005-961	0	1
1999-226	8	4	2006-001	3	2
1999-233	32	7	2006-003	2	2
2000-950	0	1	2006-008	0	1
2001-012	9	4	2006-010	32	7
2001-283	0	1	2006-011	21	5
2001-299	49	9	2006-016	3	2
2003-371	0	1	2006-023	0	1
2004-814	1	2	2006-024	5	3
2004-838	0	1	2006-025	7	4
2004-847	3	2	2006-026	4	3
2005-457	0	1	2006-027	2	2
2005-459	12	4	2006-028	20	5
2005-902	1	2	2006-038	1	2
2005-903	5	3	2006-040	9	4
2005-904	0	1			

[x]Resistance ratings assigned on a 1-9 scale in which 1-3 = resistant, 4-6 = moderately susceptible, and 7-9 = highly susceptible.

Table 9. Leaf scald resistance ratings for experimental varieties determined from an inoculated test during 2008.

Clone	Rating[x]	Clone	Rating[x]	Clone	Rating[x]
1965-357	7	2004-838	7	2006-003	8
1973-351	8	2004-847	7	2006-008	8
1979-1002	7	2005-457	6	2006-010	8
1995-988	7	2005-459	7	2006-011	6
1996-540	7	2005-902	7	2006-016	7
1997-128	6	2005-903	7	2006-023	7
1999-226	8	2005-904	7	2006-024	8
1999-233	7	2005-918	6	2006-025	8
2000-950	7	2005-920	7	2006-026	7
2001-012	5	2005-923	7	2006-027	7
2001-283	7	2005-931	7	2006-028	6
2001-299	8	2005-937	7	2006-038	8
2003-371	6	2005-961	8	2006-040	6
2004-814	7	2006-001	7		

[x]Resistance ratings assigned on a 1-9 scale in which 1-3 = resistant, 4-6 = moderately susceptible, and 7-9 = highly susceptible.