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 2009 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

The efficacy of fungicides for control of brown rust of sugarcane, caused by *Puccinia melanocephala*, was evaluated in multiple field experiments during 2009. A large experiment comparing multiple fungicides applied singly or in combinations at multiple rates with one, two, or a single delayed start application was conducted at the LSU AgCenter Sugar Research Station at St. Gabriel Louisiana. An experiment with multiple fungicide treatments applied as replicated plots was conducted in a commercial sugarcane field in Assumption Parish. A trial with complete five-row strips treated with Headline fungicide was conducted in St. Martin Parish. Data was not collected from one replicated plot experiment and two Headline strip trials due to insufficient rust development and one Headline strip trial due to weather conditions that prevented harvest.

The experiment at the Sugar Research Station included 24 treatments (Table 1). Fungicides were applied to plantcane of the brown rust susceptible variety, LCP 85-384, with a two-row CO_2 backpack sprayer. Treatments were applied on a 36 inch band to two-rows, 30 ft. in length with two non-treated rows as buffer between treatments and a 5 ft. non-treated section of row along rows between treatments. Treatments were replicated four times in a randomized complete block design. The first fungicide application date was 16 May. The delayed start single application was made on 1 June. Treatments with two applications were treated for the second time on 3 June. Rust infection was delayed due to cool spring temperatures, but once the epidemic began, symptoms were severe with extensive lesions on newly emerged leaves. Brown rust symptom severity was assessed on the youngest fully emerged leaf by image analysis only once 16 days after the first application. Rust severity was assessed by image analysis on the youngest fully emerged leaf for eight leaves per plot.

All fungicide treatments in the Sugar Research Station experiment reduced rust severity compared to the non-treated control, and differences in ability to suppress rust severity were detected among fungicide treatments (Table 2). Harvesting conditions were poor, wet with extreme lodging in some sections of the field, so the yield results (Table 1) should be interpreted cautiously. The treatment consisting of two applications of Headline at 6 oz/acre tank mixed with

Caramba at 8 oz/acre increased cane tonnage yield 12.5 tons (50%) and sugar per acre by 2,221 lbs. (47%). This difference is the greatest observed in any experiment conducted in Louisiana to this point. The Section 18 treatment of two applications of Headline at 9 oz/acre increased tonnage yield 9 tons (36%) and sugar yield 1,381 lbs. (29%). Headline applied only one time increased yield only when applied at 12 oz/acre. A delayed single application of Headline increased yield only at the 9 oz rate. Pre-mixes of pyraclostrobin and metconazole increased yield only with the UUF formulation. The Bayer pre-mixes did not consistently increase yield. The Dupont fungicide did not increase yield.

Fungicides were applied to HoCP 96-540 plantcane with a brown rust epidemic already underway in a field in Assumption Parish. This experiment evaluated the ability of different treatments to reduce rust severity and prevent yield loss after the disease was already established in the crop. Ten treatments (Table 3) were applied with a backpack sprayer as described above on a 36 inch band to two-rows, 30 ft. in length with two non-treated rows as buffer between treatments and a 5 ft. non-treated section of row along rows between treatments. Treatments were replicated four times in a randomized complete block design. Most treatments consisted of two applications made on 28 April and 19 May (21 day interval). One treatment of a tank mix of Headline + Caramba was applied three times on 29 April, 12 May, and 28 May. Rust symptom severity was assessed by image analysis once on 12 May (14 days after the first fungicide application). The leaf area affected by rust lesions was determined on the second fully emerged leaf for eight leaves per plot. Millable stalks per plot were counted on 23 July, and the field was harvested on 4 January, 2010. The cane was lodged at the time of harvest.

Brown rust symptom severity was only moderate (11% for leaves in non-treated plots) at the time of assessment, and no significant reductions were detected in plots with different fungicide treatments. Rust symptom severity began to abate naturally soon after the first fungicide application. Variation in the degree of cane lodging caused some variability in the yield data collected, and the experiment results may have been affected. The only significant difference detected was an increase in sugar per acre of 1,528 lbs (15%) in the plots receiving one application of Headline at 9 oz/acre compared to the non-treated control.

Four 5-row strips of HoCP 96-540 plantcane were treated either once or twice with Headline at 9 oz/acre applied on a 36 inch band to a field in St. Martin Parish. Application dates were 30 April and 21 May. The first Headline application was made just before severe brown rust symptoms developed in non-treated rows. The leaf area occupied by rust lesions was 17.3% for the youngest fully emerged leaf in the non-treated rows compared to 1.2% for Headline treated leaves 12 days after the first application, indicating that rust was effectively controlled by the fungicide application. Rust symptoms began to abate naturally after the first application; however, a second application was made for comparison. Millable stalk populations were determined on 24 July, and the field was harvested on 3 December. The field was lodged at the time of harvest.

Millable stalk population and stalk weight were increased by both one and two applications of Headline (Table 4). Cane tonnage and sugar per acre yield were only significantly increased in the single Headline application treatment compared to the non-treated control. Tonnage was increased 3.4 tons (7%), and sugar yield was increased 777 lbs. (8%). The

increases in stalk population and weight suggested that tonnage would be higher in the two application treatment. Challenging conditions at harvest may have prevented the detection of treatment differences.

Brown rust symptom severity 16 days after Headline treatment was 8.7% for non-treated leaves (youngest fully emerged leaf) compared to 1.2% for treated rows in an experiment in St. Mary Parish with entire treated rows of HoCP 96-540 plantcane that was not harvested.

The 2009 experimental results continue to indicate that the treatment allowed by the Section 18 emergency use label to control brown rust (up to two applications of Headline fungicide at a rate of 9 oz/acre) will provide a positive economic return when an epidemic begins in April or May. LCP 85-384 currently sustains more damage from rust, and the benefits of control are greater. The Headline strip trial with HoCP 96-540 provides the first results with the variety now occupying the most acreage in Louisiana. At this time, epidemics of brown rust in HoCP 96-540 are of shorter duration, and the resulting yield loss is less. However, a well-timed fungicide application will prevent significant yield loss and provide a positive economic return. The Assumption Parish experiment results with fungicides applied to plants with rust already established on the newly emerged leaves supports the results of tests in previous years with already rust-infected LCP 85-384. This “rescue mission” approach reduces the severity of symptoms on new leaves and may reduce the impact of the disease on yield. However, the economic benefit is much less than when fungicide is applied prior to the infection of the young, newly emerged leaves that contribute the most to plant growth. Other fungicides and fungicide combinations continue to reduce brown rust symptom severity and associated yield loss. The results indicate that additional possibilities exist to provide cost effective treatments for brown rust control in Louisiana.

HEALTHY SEEDCANE PROGRAM SUPPORT AND DISEASE DETECTION METHODS

Ratoon stunting disease (RSD) testing was conducted by the Sugarcane Disease Detection Lab for the 13th year during 2009. 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 5). A total of 2,789 samples were tested. No RSD was detected at any level of Kleentek production or in ASCL Variety Release Program samples. Little RSD testing was performed on commercial farms. RSD was only detected in one of 39 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 6). A total of 10,013 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.

Six 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 basis of resistance to leaf scald is in progress. The proteins (gene products) produced by a leaf scald resistant variety, Ho 95-988, and a susceptible variety, HoCP 89-846, are being compared in inoculated and non-inoculated plants. Proteins that are differentially regulated following infection by *Xanthomonas albilineans* have been observed. Selected 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. The highest frequencies of resistance were detected among *Saccharum barberi* and *S. spontaneum* accessions. Three of 31 *S. spontaneum* (10%) and four of 14 *S. barberi* (29%) accessions exhibited high resistance to red rot. All *Erianthus* accessions were highly resistant. The most easily utilized sources of resistance will be selected *S. barberi* and *S. spontaneum* clones.

VARIETY SELECTION

Disease resistance levels were evaluated as a routine part of the Variety Selection Program. Inoculated tests to determine resistance levels in experimental varieties to smut and leaf scald were not conducted during 2009 because of Hurricane Gustav. Visual ratings were used to evaluate resistance to brown rust in out-field yield trial plots.

Table 1. Effect of fungicides on yield of LCP 85-384 plantcane in Sugar Research Station experiment conducted during 2009.

Treatment[1]	Stalk weight (lbs.)[2]	Sugar/ton (lbs.)[2]	Tons cane per acre[2]	Sugar/acre (lbs.)[2]
Non-treated	1.81 abc	187 abcde	25.2 g	4703 g
Headline 6 oz, 1 application	1.81 abc	181 cde	29.0 cdefg	5240 fg
Headline 6 oz, 2 applications	1.87 abc	195 abc	33.2 abcde	6472 abcde
Headline 6 oz, 1 application delayed start	1.62 bc	184 abcde	30.2 cdefg	5567 cdefg
Headline 9 oz, 1 application	1.79 abc	189 abcde	28.0 defg	5271 fg
Headline 9 oz, 2 applications	1.79 abc	178 e	34.2 abcd	6084 abcdef
Headline 9 oz, 1 application delayed start	1.94 a	180 de	33.2 abcde	5999 abcdef
Headline 12 oz, 1 application	1.76 abc	192 abcd	35.0 abc	6730 abc
Headline 12 oz, 2 applications	1.93 a	185 abcde	31.7 bcdefg	5852 bcdefg
Headline 12 oz, 1 application delayed start	1.69 abc	184 abcde	29.8 cdefg	5485 efg
Headline 6 oz + Caramba 8 oz, 1 app.	1.87 abc	190 abcde	33.5 abcde	6139 abcdef
Headline 6 oz + Caramba 8 oz, 2 app.	1.89 ab	182 cde	37.8 a	6924 a
Headline 6 oz + Caramba 8 oz, 1 application delayed start	1.73 abc	178 de	29.7 cdefg	5639 bcdefg
BASF 01F 9 oz, 2 applications	1.72 abc	181 cde	30.5 cdefg	5529 defg
BASF 01F 11 oz, 2 applications	1.80 abc	196 ab	27.8 efg	4955 fg
BASF UUF 10 oz, 2 applications	1.76 abc	178 e	37.0 ab	6703 abcd
BASF UUF 12 oz, 2 applications	1.71 abc	182 bcde	34.5 abc	6768 ab
Caramba 14 oz, 2 applications	1.67 abc	187 abcde	28.8 cdefg	5090 fg
Stratego 19 oz, 2 applications	1.89 ab	182 bcde	30.2 cdefg	5495 efg
Bayer 1, 8 oz, 1 application	1.79 abc	187 abcde	32.8 abcdef	6144 abcdef
Bayer 1, 8 oz, 2 applications	1.75 abc	189 abcde	26.8 fg	5004 fg
Bayer 1, 8 oz, 1 application delayed start	1.91 ab	197 a	30.2 cdefg	5965 abcdef
Bayer 2, 2 applications	1.75 abc	183 abcde	31.2 bcdefg	5718 bcdefg
Dupont 24 oz, 2 applications	1.59 c	186 abcde	29.0 cdefg	5370 efg

[1]First application May 16; second application June 3; delayed start application June 1.
[2] Means within columns followed by different letters were significantly different (*P*=0.05).

Table 2. Reductions in brown rust symptom severity provided by different fungicide treatments in LCP 85-384 plantcane in Sugar Research Station experiment conducted at during 2009.

Fungicide treatment[1]	Brown rust severity (%)[2]
Non-treated control	27.9 a
Headline 6 oz, 1 application	5.8 cd
Headline 9 oz, 1 application	5.9 cd
Headline 12 oz, 1 application	4.3 d
Headline 6 oz + Caramba 8 oz, 1 application	5.1 cd
BASF 01F 9 oz, 2 applications	18.2 b
BASF 01F 11 oz, 2 applications	7.7 cd
BASF UUF 10 oz, 2 applications	11.1 cd
BASF UUF 12 oz, 2 applications	8.4 cd
Stratego 19 oz, 2 applications	6.9 cd
Bayer 1, 8 oz, 1 application	11.3 bc
Bayer 2, 2 applications	8.2 cd
Dupont 24 oz, 2 applications	7.3 cd

[1]All fungicides applied on 5/16/09 with 0.125% non-ionic surfactant (except Dupont with 0.25%).
[2]Rust leaf infection percentage determined by image analysis on youngest fully emerged leaf at 16 days after fungicide application. Percentage means followed by different letters were significantly different (*P*=0.05).

Table 3. Effect of fungicides on brown rust severity and yield of HoCP 96-540 plantcane in experiment conducted in Assumption Parish during 2009.

Treatment[1]	Rust severity (%)	Stalks/acre (x1000)	Stalk weight (lbs.)	Sugar/ton (lbs.)	Tons cane/acre	Sugar/acre (lbs.)[2]
Non-treated	10.8	40.8	2.43	202	50.7	10199 bc
Headline 9 oz, 1 app.	6.3	44.2	2.33	203	58.0	11727 a
Headline 9 oz, 2 app.	--	45.6	2.49	218	53.0	11522 ab
Headline 12 oz, 1 app.	2.1	42.9	2.43	209	52.5	10898 ab
Headline 6 oz + Caramba 8 oz, 1 app.	4.7	42.2	2,34	214	51.5	10988 ab
Headline 6 oz + Caramba 8 oz, 2 app.	--	44.3	2.33	205	51.3	11073 ab
Headline 6 oz + Caramba 8 oz, 3 app.	3.4	43.3	2.19	201	53.7	9357 c
BASF 01F 9 oz, 2 app.	3.9	42.2	2.49	207	46.7	10572 abc
BASF UUF 10 oz, 2 app.	3.9	43.9	2.59	208	51.3	10220 bc
Bayer USF 8 oz, 2 app.	2.7	42.6	2.36	198	49.3	10365 abc

[1]First fungicide application (app.) 4/28; 2 week treatment (second application) 5/12; second regular application 5/19; 2 week treatment (third application) 5/28.
[2] Means followed by different letters were significantly different (*P*=0.05).

Table 4. Effect of Headline fungicide (9 oz/acre rate) applied on 36 inch band to entire 5-row strips of HoCP 96-540 plantcane in St. Martin Parish during 2009.

Treatment[1]	Stalks/acre (x1000) [2]	Stalk weight (lbs.) [2]	Sugar/ton (lbs.)	Tons cane per acre[2]	Sugar/acre (lbs.) [2]
Non-treated	38.2 b	2.51 b	199	45.7 b	9123 b
Headline 1 application	40.9 a	2.67 a	201	49.1 a	9900 a
Headline 2 applications	41.5 a	2.65 a	199	47.2 ab	9293 b

[1]First fungicide application 4/30; second application 5/21.
[2]Means within columns followed by different letters were significantly different (*P*=0.05).

Table 5. RSD testing summary for 2009.

Source	Location	No. of fields	No. of varieties	No. of samples
Louisiana growers	State-wide	39	11	875
Variety Release Program	1° & 2° stations	-	28	821
Helena SugarTech®	Foundation stock	-	2	28
Kleentek®	Foundation stock	-	13	36
Kleentek®	Other than foundation	50	12	764
Local Quarantine	LSUAC	-	12	40
Research	LSUAC	9	9	225
Totals		98	87	2789

Table 6. Sugarcane yellow leaf virus testing summary for 2009.

Source	Location	No. of fields	No. of varieties	No. of samples
LDAF	Seed Certification	187	-	6004
Helena SugarTech®	Foundation stock	-	2	56
Kleentek®	Foundation stock	36	6	721
Kleentek®	Other than foundation	-	60	2752
Local Quarantine	LSUAC	-	16	69
Research	LSUAC	-	4	411
Totals		223	88	10013