PATHOLOGY RESEARCH

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Pathology research addresses the important diseases affecting sugarcane in Louisiana. The overall program goal is to provide farmers with practices to minimize losses to diseases in a cost-effective manner. Projects receiving emphasis during 2013 included: improving control methods for brown rust, support of healthy seedcane programs to manage ratoon stunting disease and other systemic diseases, improving the evaluation of resistance to leaf scald, evaluating disease resistance in the variety selection program, and billet planting. Research results on billet planting are reported separately.

BROWN RUST

A very warm winter followed by a very cold spring resulted in an erratic, moderately severe brown rust epidemic in the southern part of the industry during 2013. Research was conducted to evaluate the efficacy of fungicides and minor elements for brown rust control. Field experiments were conducted at the Sugar Research Station at St. Gabriel with BASF and Syngenta Crop Protection fungicides. The potential of Ni and Cu for brown rust suppression also was evaluated in one of the experiments at the Sugar Research Station. Large scale demonstration strip trials were conducted on commercial farms to determine the cost effectiveness of Quilt Xcel® fungicide and other fungicides for rust control. The cool temperatures during May limited plant growth, and yield responses to fungicide application were lower as a result.

A field experiment comparing three Syngenta fungicides applied at different rates and one combination treatment and a labeled BASF fungicide was conducted in plant cane of a brown rust susceptible variety, HoCP 96-540, at the Sugar Research Station at St. Gabriel. Fungicides were applied on a 36 inch band with a two-row CO_2 backpack sprayer. Treatments were applied 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. Each treatment was replicated four times in a randomized complete block design. Fungicide application dates were April 23 and May 21. Brown rust symptom severity was assessed on the youngest fully emerged leaf by image analysis once 11 days after the second application. Yield components, including stalk population, stalk weight, sucrose per ton of cane, cane tonnage, and total sucrose, were determined and compared.

All fungicide treatments reduced rust severity compared to the non-treated control, and differences in ability to suppress rust severity were detected among fungicide treatments (Table 1). Two experimental fungicides, a combination of the two experimental fungicides, and Headline fungicide reduced rust symptoms more than a Quilt Xcel treatment. Six Syngenta fungicide treatments increased cane tonnage and five of the same treatments increased total sugar yield compared to the non-treated control (Table 2). Headline treatment increased stalk weight

compared to the non-treated control (Table 2). Some differences were detected among fungicide treatments in stalk sucrose content (Table 2). Stalk population was not affected by the treatments.

Table 1. Reductions in brown rust symptom severity provided by different fungicide treatments in HoCP 96-540 plant cane in Sugar Research Station experiment comparing Syngenta fungicides during 2013.

Treatment[1]	Brown rust severity (%)[2]
Non-treated control	23.8 a
Quilt Xcel 16 oz/acre	12.2 bc
Quilt Xcel 18 oz/acre	12.9 bc
Quilt Xcel 21 oz/acre	16.6 b
A15457 10.3 oz/acre	9.4 cd
A15457 13.7 oz/acre	9.7 cd
A18993 13.7 oz/acre	6.8 d
A18993 18.3 oz/acre	9.3 cd
A18993 13.7 oz/acre then Quilt Xcel 21 oz/acre	8.2 cd
Headline 12 oz/acre	10.8 cd

[1]All fungicides applied on 4/23/13 and 5/21/13 with 0.125% non-ionic surfactant.
[2]Rust leaf infection percentage determined by image analysis on youngest fully emerged leaf on 6/1/13 at 11 days after the second fungicide application. Percentage means followed by the same letter were not significantly different (*P*=0.05).

Table 2. Effects of fungicides on yield components of HoCP 96-540 plant cane in a Sugar Research Station experiment comparing Syngenta and BASF fungicides during 2013.

Treatment[1]	Stalks/acre[2]	Stalk weight (lbs.)[2]	Sugar/ton (lbs.)[2]	Tons cane/acre[2]	Sugar/acre (lbs.)[2]
Non-treated control	51,948 a	1.7 b	208.5 ab	32.7 e	6815 d
Quilt Xcel 16 oz/acre	53,210 a	1.9 ab	205.8 abc	33.6 de	6898 cd
Quilt Xcel 18 oz/acre	53,857 a	1.8 b	210.6 a	41.2 ab	8683 a
Quilt Xcel 21 oz/acre	51,333 a	1.7 b	208.1 abc	38.6 abc	8026 abc
A15457 10.3 oz/acre	53,696 a	1.9 ab	199.2 abc	34.1 cde	6777 d
A15457 13.7 oz/acre	52,531 a	1.9 ab	195.8 bc	39.7 ab	7774 abcd
A18993 13.7 oz/acre	54,731 a	1.7 b	210.0 ab	38.1 abc	7818 abcd
A18993 18.3 oz/acre	52,077 a	1.8 b	193.7 c	43.4 a	8447 ab
A18993 13.7 oz/acre then Quilt Xcel 21 oz/acre	51,430 a	1.9 ab	211.2 a	40.1 ab	8435 ab
Headline 12 oz/acre	52,530 a	2.1 a	204.1 abc	36.5 bcde	7460 bcd

[1]All fungicides applied on 4/23/13 and 5/23/13 with 0.125% non-ionic surfactant.
[2]Means within a column followed by the same letter were not significantly different (*P*=0.05).

A field experiment comparing 10 BASF fungicide treatments, one Syngenta fungicide, two Manniplex Ni (Brandt Consolidated, Inc. nickel product) treatments, and one fungicide plus Ni treatment was conducted in plant cane of HoCP 96-540 at the Sugar Research Station at St. Gabriel as described above. Fungicide application dates were April 22 and May 13. Brown rust

symptom severity was assessed on the youngest fully emerged leaf by image analysis once 14 days after the second application.

All fungicide and Ni treatments reduced rust severity compared to the non-treated control, and differences in ability to suppress rust severity were detected among fungicide and Ni treatments (Table 3). Cool weather after fungicide application resulted in slow plant growth and no differences between treatments and the non-treated control (Table 4). Cane tonnage was higher for the Headline + Priaxor 7.5 oz/acre treatment than for the Quilt Xcel and Sercadis 6 oz/acre treatments, and total sugar yield was higher for the Headline + Priaxor 7.5 oz/acre treatment than for the Sercadis 4.5 oz/acre treatment (Table 4).

Table 3. Reductions in brown rust symptom severity provided by different fungicide and Ni treatments in HoCP 96-540 plant cane in Sugar Research Station experiment comparing BASF fungicides and Manniplex Ni during 2013.

Treatment[1]	Brown rust severity (%)[2]
Non-treated control	26.7 a
Sercadis 4.5 oz/acre	17.5 b
Sercadis 6.0 oz/acre	10.0 c
Priaxor 5 oz/acre	4.9 d
Priaxor 8 oz/acre	5.1 d
Priaxor 5 oz/acre + Headline Amp 12 oz/acre	5.1 d
Priaxor 7.5 oz/acre + Headline Amp 12 oz/acre	6.4 cd
Headline Amp 12 oz/acre + Priaxor 5 oz/acre	5.4 cd
Headline Amp 12 oz/acre + Priaxor 7.5 oz/acre	4.2 d
Quilt Xcel 18 oz/acre	9.8 c
Headline 12 oz/acre	6.2 cd
Headline SC 9 oz/acre	7.1 cd
Headline SC 9 oz/acre + Manniplex Ni 1 pt/acre	5.1 d
Manniplex Ni 1 pt/acre	17.5 b
Manniplex Ni 2 pt/acre	17.9 b

[1]All fungicides applied on 4/22/13 and 5/13/13 with 0.125% non-ionic surfactant.
[2]Rust leaf infection percentage determined by image analysis on youngest fully emerged leaf on 5/27/13 at 14 days after second fungicide application. Percentage means followed by the same letter were not significantly different (P=0.05).

Four field experiments in which Quilt Xcel fungicide was applied once or twice to multiple, complete 6-10 row strips of HoCP 96-540 plant cane were conducted to evaluate the impact of brown rust on cane tonnage yield of HoCP 96-540 and to provide a cost/benefit analysis of fungicide application. Quilt Xcel was compared to Headline and Headline/Caramaba fungicide applications in some experiments, and a banded and broadcast application was compared in one (Table 5). The Iberville Parish experiment was conducted by Dr. Blaine Viator, and the St. James Parish experiment was conducted by Dr. A. Orgeron. Brown rust severity was higher in treated than non-treated plots in the St. Martin and St. Mary Parish experiments. In the St. Martin experiment, brown rust severity on the top visible dewlap leaf was 24 and 4% for the non-treated and treated rows, respectively. In the St. Mary experiment, rust severities were 31, 21, and 18% for the non-treated, single application, and two application rows, respectively. Yield

was determined and compared in treated and non-treated sets of rows for all experiments. Yields were determined by tracking truck weights at the mill. Yields were not significantly different among treatments at all locations (Table 5).

Table 4. Effects of fungicides and Ni on yield components of HoCP 96-540 plant cane in Sugar Research Station experiment comparing BASF fungicides and Manniplex Ni during 2013.

Treatment[1]	Stalks/acre (x1000) [2]	Stalk weight (lbs.) [2]	Sugar/ton (lbs.) [2]	Tons cane/acre[2]	Sugar/acre (lbs.) [2]
Non-treated control	49294 abc	2.0	193.5	41.5 ab	8024 abc
Sercadis 4.5 oz/acre	49261 abc	1.9	187.9	38.8 ab	7256 c
Sercadis 6.0 oz/acre	48905 abc	2.0	194.7	38.0 b	7364 bc
Priaxor 5 oz/acre	48905 abc	2.0	189.9	48.0 ab	9037 ab
Priaxor 8 oz/acre	49035 abc	1.9	192.9	45.1 ab	8604 abc
Priaxor 5 oz/acre + Headline Amp 12 oz/acre	45863 c	2.1	188.4	45.6 ab	8499 abc
Priaxor 7.5 oz/acre + Headline Amp 12 oz/acre	47870 bc	2.1	193.1	44.1 ab	8403 abc
Headline Amp 12 oz/acre + Priaxor 5 oz/acre	47934 bc	2.2	186.7	41.7 ab	7802 abc
Headline Amp 12 oz/acre + Priaxor 7.5 oz/acre	45734 c	2.0	188.8	49.1 a	9257 a
Quilt Xcel 18 oz/acre	49585 abc	2.2	198.2	38.2 b	7603 abc
Headline 12 oz/acre	51915 a	2.1	197.5	40.7 ab	8001 abc
Headline SC 9 oz/acre	48646 abc	1.9	198.2	43.3 ab	8489 abc
Headline SC 9 oz/acre + Manniplex Ni 1 pt/acre	48355 abc	2.0	194.7	41.5 ab	8043 abc
Manniplex Ni 1 pt/acre	48387 abc	2.0	205.3	42.3 ab	8681 abc
Manniplex Ni 2 pt/acre	50427 ab	2.0	193.9	40.5 ab	7847 abc

[1]All fungicides applied on 4/1/12 and 4/26/12 with 0.125% non-ionic surfactant.
[2]Means within a column followed by the same letter were not significantly different (P=0.05).

Research is on-going to develop molecular markers for brown rust resistance in cooperation with Dr. Niranjan Baisakh. A suppression subtractive library was constructed using cDNA derived from fungus inoculated plants of L 99-233, and 364 genes were sequenced from the subtraction library. Functional annotation of 215 unigenes indicated that 144 transcripts coded for proteins of unknown function and 17 were retrotransposons. Eighteen of the other 54 genes belonged to the protein kinase family and transcriptional regulators, while the others were genes known to be associated with stress tolerance in other species. Molecular mapping has been initiated with 187 self progeny of L 99-233, L99-233, and its parents. The L 99-233 self population is being phenotyped for brown rust resistance using the controlled conditions inoculation system and natural infection.

ORANGE RUST DURING 2013

Orange rust caused by the fungus, *Puccinia kuehnii*, was found for the first time in Louisiana during 2012 in the newly released variety Ho 05-961 by USDA-ARS Sugarcane Research Unit personnel. Increase plots of this variety still remained on the secondary increase stations for the American Sugar Cane League Variety Release Program during 2013, and disease severity was visually assessed. Disease severity was lower than in 2012. However, orange rust was observed in fields of CP 89-2143 at two farms. Severe disease symptoms were observed in fields in St. Mary Parish, and orange rust was detected in a field of HoCP 00-950 adjacent to diseased CP 89-2143.

Table 5. Fungicide strip trial results from four experiments during 2013.

Location	Treatment	Non-treated tons of cane per acre	Treated tons of cane per acre	Difference
St. Martin	One application	41.9	43.9	+2.0
St. Mary	One application	43.5	44.9	+1.4
	Two applications		44.8	+1.3
Iberville	Quilt Xcel band	48.7	52.2	+3.5
(B. Viator)	Quilt Xcel broadcast		51.9	+3.1
	Headline broadcast		51.6	+2.9
St. James	Quilt Xcel	42.5	42.1	-0.4
(A. Orgeron)	Headline/Caramba 6 oz/8 oz		42.7	+0.2
	Headline/Caramba 9 oz/8 oz		42.6	+0.1
	Headline/Caramba 9 oz/12 oz		43.2	+0.7

HEALTHY SEEDCANE PROGRAM SUPPORT

Disease testing was conducted by the Sugarcane Disease Detection Lab for the 18th year during 2013. Kleentek and SugarTech seedcane production was monitored for ratoon stunting disease (RSD), and no disease was detected. A total of 2,478 stalk samples from research farms, variety increase plots, and grower fields were tested for RSD with no positives detected (Table 6). Limited testing was conducted on commercial farms. A total of 9,011 leaf samples were tested for yellow leaf (Table 7). Commercial tissue-culture seedcane sources were tested as part of the LDAF seedcane certification program. No field failed to certify due to virus infection. The Local Quarantine supplied healthy plant material of promising experimental varieties to the two seedcane companies.

RESISTANCE TO LEAF SCALD

The primary control measure for leaf scald is host plant resistance. The current system of resistance evaluation using visual rating of disease severity can be uncertain due to erratic symptom expression. A quantitative polymerase chain reaction (qPCR) assay has been developed with demonstrated potential for resistance screening. The highest correlation between qPCR and visual ratings was determined to occur at 8 weeks after inoculation. The high sensitivity, specificity, and consistency suggest that qPCR can provide an improved method to evaluate resistance to leaf scald in sugarcane. The correlation was determined for the first time between visual ratings based on systemic symptom severity and bacterial population determined by qPCR for the 2013 variety selection program leaf scald inoculation trial including commercial and experimental varieties (Table 8). The Spearman's rank correlation coefficient was 0.57.

Table 6. RSD testing summary for 2013.

Source	Location	No. of fields	No. of varieties	No. of samples
Louisiana growers	State-wide	9	5	189
Variety Release Program	1° & 2° stations	-	15	952
Helena SugarTech®	Foundation stock	-	-	-
Kleentek®	Foundation stock	-	-	19
Kleentek®	Other than foundation	-	-	967
Local Quarantine	LSUAC	-	18	108
Research	LSUAC	-	-	243
Totals		9	38	2478

Table 7. Sugarcane yellow leaf virus testing summary for 2013.

Source	Location	No. of fields	No. of varieties	No. of samples
LDAF	Seed Certification	187	-	5648
Helena SugarTech®	Foundation stock	-	4	76
Kleentek®	Foundation stock	-	29	68
Kleentek®	Other than foundation	-	-	2971
Local Quarantine	LSUAC	-	18	108
Research	LSUAC	-	-	140
Totals		187	51	9011

Table 8. Leaf scald resistance ratings determined in an inoculated test for commercial and experimental sugarcane varieties during 2013.

Variety	Leaf scald visual rating[1]	RT-PCR rating	Variety	Leaf scald visual rating[1]	RT-PCR rating
CP 73-351	7	7	L 10-147	8	7
LCP 85-384	5	4	L 10-156	5	4
L 01-040	5	4	Ho 10-917	7	8
L 01-299	7	5	Ho 10-937	6	5
HoCP 07-613	7	6	L 11-168	6	6
L 08-090	8	8	L 11-172	6	3
Ho 08-730	8	7	L 11-173	6	6
L 09-099	8	4	L 11-178	8	7
L 09-112	5	1	L 11-180	5	3
L 09-131	7	7	L 11-183	6	2
HoCP 09-800	5	3	L 11-185	7	6
HoCP 09-804	4	3	L 11-187	8	7
HoCP 09-814	6	5	L 11-190	8	8
Ho 09-840	7	5	L 11-191	7	7
L 10-146	8	4	N27	7	5

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