PATHOLOGY RESEARCH

J. W. Hoy, L. B. Grelen, C. F. Savario, and J. Q. Paccamonti
Department of Plant Pathology and Crop Physiology

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 2005 included: ratoon stunting disease (RSD) management, evaluating the effect of brown rust on yield and possible control measures, assessing the treat posed by yellow leaf and control measures, improving our understanding of root disease, and billet planting. Research results on billet planting are reported separately.

RATOON STUNTING DISEASE

RSD testing was conducted by the Sugarcane Disease Detection Lab for the 9th year during 2005. 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® seedcane production system (Table 1). No RSD was detected at any level of Kleentek production or in ASCL Variety Release Program samples. On-farm RSD testing was low due to the hurricanes. Forty-nine fields were sampled on ten farms. RSD was detected in 10% of the farms, 2% of the fields, and 0.3% of the stalks tested. RSD was detected in second stubble (Table 2) of field-run cane (Table 3). In addition to RSD testing, seven 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.

Table 1. RSD testing summary for 2005.

Source	Location	No. of fields	No. of varieties	No. of samples
Louisiana growers	State-wide	49	8	937
LSUAC	St. Gabriel & Iberia	-	15	189
Variety Release Program	1° & 2° stations	-	7	468
Helena	Foundation stock	-	8	28
Kleentek®	Foundation stock	-	6	25
Kleentek®	1° increase farms	23	5	374
Kleentek®	2° increase farms	33	4	656
Local Quarantine	LSUAC	-	16	135
Research	LSUAC	-	-	1060
Totals		105		3872

Table 2. RSD field and stalk infection frequencies in different crop cycle years for all varieties combined during 2005.

Crop Year	Total number of fields	Average field infection (%)	Total number of stalks	Average stalk infection (%)
Plantcane	26	0.0	490	0.0
First stubble	8	0.0	160	0.0
Second stubble	11	9.1	207	1.4
Older stubble	4	0.0	80	0.0
Totals/Averages	49	2.0	937	0.3

Table 3. RSD field and stalk infection frequencies as affected by seedcane programs for all varieties combined during 2005.

Seedcane program	Total number of fields	Average field infection (%)	Total number of stalks	Average stalk infection (%)
Heat-treated	-	-	-	-
Kleentek®	10	0.0	197	0.0
ASCL	23	0.0	419	0.0
Field-run	16	6.3	321	0.9
Totals/Averages	49	2.0	937	0.3

BROWN RUST

Field experiments were conducted on commercial farms to evaluate the effect of brown rust on yield of LCP 85-384 and the efficacy of fungicides for rust control. Similar experiments have been established for 2006.

Yield loss experiment:

The experiment was conducted in a LCP 85-384 plantcane field on a commercial farm in St. Mary Parish. The methods used were the same as for two experiments conducted during 2004. A combination of three fungicides, Folicur (tebuconazole), Quadris (azoxystrobin), and Tilt (propiconazole) were applied with a CO_2 backpack sprayer every two weeks once the rust epidemic began. Fungicide treatments were started and stopped at different times to determine when rust was having the greatest impact on yield. Experimental plots consisted of four rows 70 ft. in length with four replications. Rust intensity was assessed at different dates by image analysis using leaves collected from each plot. The rust started later in 2005 than in 2004, so treatments did not begin until May. Cane tonnage was determined using a weigh wagon to record the total weight of harvested cane for each plot, and sugar/acre was calculated with these tonnage figures.

Fungicides applied only in May did not reduce rust intensity or significantly increase yield (Table 4). However, spraying in May and June increased cane tonnage by 6.6 tons/acre (18%) and sugar/acre by 931 lbs. (11%). Spraying only in June resulted in a significant decrease in rust intensity and an increase in tonnage yield. Tonnage was increased by 4.8 tons (13%) and sugar by 1,043 lbs. (12%). The millable stalk population and stalk weight were slightly higher in the May-June and June fungicide treated plots, and these nonsignificant increases together resulted in the tonnage increases.

Table 4. Effect of brown rust on yield of LCP 85-384, St. Mary Parish, 2005.

Fungicide treatment dates				Percent rust (July)	Stalk no./acre (x1000)	Stalk weight (lbs.)	Sugar/ton (lbs.)	Tons/acre	Sugar/acre (lbs.)
None				38.1 B	47.5	1.74	235.9	35.7 B	8417
5/3	5/17			45.1 B	51.0	1.95	231.1	37.2 B	8611
5/3	5/17	6/2	6/15	4.1 A	48.3	1.81	221.7	42.3 A	9348
		6/2	6/15	4.0 A	49.6	1.80	233.7	40.5 AB	9460

Values within columns followed by different letters were significantly different (P=0.05).

Rust reduced cane tonnage in an experiment conducted in Iberia Parish during 2004 by 7 tons (21%). This reduction was similar to that obtained from the 2005 experiment, but the sugar/acre loss caused by rust was less in 2005 (11%) compared to 2004 (28%). Sugar/ton was higher for the rust infected cane during 2005. It should be noted, however, that fungicides applied from April through June did not increase yield in an experiment conducted in St. James Parish during 2004. The rust epidemic began but never became severe in this field.

The results from 2004 and 2005 demonstrate that rust can significantly reduce yield of LCP 85-384. The magnitude of the yield increases obtained with the combination fungicide treatments suggests that the use of fungicides as a rust control measure for farmers should be explored. Therefore, experiments were conducted during 2005 to determine the efficacy of single or combined fungicides for rust control at different times of application.

Fungicide efficacy experiments:

Two field experiments were conducted during 2005 to evaluate the effects of treatment with different fungicides on rust severity and yield. One experiment was initiated in May in a plantcane field of LCP 85-384 in Lafourche Parish. A second experiment was initiated in June in a plantcane field of LCP 85-384 in Iberia Parish.

Seven fungicide treatments were compared to no fungicide treatment. They were: Domark (tetraconazole), Folicur (tebuconazole), Headline (pyraclostrobin) + Folicur, Quadris (azoxystrobin), Quilt (Quadris + Tilt), Tilt (propiconazole), and the combination used in the yield loss experiments (Folicur + Quadris + Tilt). Domark, Folicur, and Tilt have similar modes of action, and Headline and Quadris have similar modes of action. Headline + Folicur was available packaged together, and Quilt is a single product containing Quadris + Tilt together. Rates of application were recommended by the companies making the different products. The rates of application for the seven treatments were 6 oz/acre of formulated product (FP) for Domark, 6 oz/acre FP for Folicur, 6 oz/acre FP Headline + 4 oz/acre FP Folicur, 9 oz/acre FP for Quadris, 14 oz/acre FP for Quilt, 4 oz/acre FP for Tilt, and 6 oz/acre FP Folicur + 10 oz/acre FP Quadris + 6 oz/acre FP Tilt.

In the Lafourche experiment, fungicides were applied on 13 May (1st rust) only, on 3 June only, or on both dates. Rust was just beginning to appear in mid-May in the test field, and the second fungicide application was timed to coincide with the probable loss of effect from the 13 May application. All but one fungicide treatment significantly reduced rust severity (Table 5). The most effective treatments tended to be the combination fungicides applied in May and June. However, the only fungicide treatment that significantly increased cane tonnage compared to the no fungicide treatment was Quadris applied on 3 June only. The next best treatments were Folicur applied on 3 June only and the three fungicide combination applied on both dates. The rust epidemic and plant growth in the test field appeared to be erratic possibly due to recent land-leveling. Sugar/acre yields were particularly erratic. However, the fact is that reductions in rust resulting from fungicide applications did not lead to significant yield increases in this experiment.

Following several hard freezes during the 2004/2005 winter and a cold spring, the occurrence of rust was erratic during the 2005 growing season. Crop growth also was erratic and delayed by weather conditions. Rust usually begins to decrease in intensity during June as temperatures increase, so with the late start for the epidemic, it was anticipated that rust would not be severe in the Louisiana industry during 2005. However, rust continued to spread north into new fields during June and July of 2005. When it became apparent that rust was continuing to spread, it was decided to conduct a second fungicide experiment. The objective would be to determine if the fungicides being evaluated could halt an epidemic that was already in progress.

The same fungicide treatments as in the Lafourche experiment were applied to a plantcane field of LCP 85-384 in Iberia Parish in which rust was already strongly evident. A single application only was made on 10 June. Rust severity was determined and compared in July, and millable stalk counts were made during August. Due to difficulties encountered by the farmer following Hurricane Rita, no tonnage or sugar yields were determined.

Fungicides applied to a field with a severe rust epidemic in progress failed to reduce subsequent rust intensity (Table 6). This included the three fungicide combination that was effective in controlling rust in the yield loss experiments. In addition, no fungicide treatment improved millable stalk population (Table 6).

Table 5. Effects of fungicide treatments on rust severity and yield of LCP 85-384 plantcane, Lafourche Parish, 2005.

Fungicide	Treatment	Percent rust (July)	Stalks/acre (x1,000)	Stalk wt. (lbs.)	Sugar/ton (lbs.)	Tons/acre	Sugar/acre (lbs.)
No fungicide	None	41.8 A	49.9	1.26	220	32.9 BCD	7239 BC
Domark	13 May	24.5 AB	51.8	1.36	199	35.0 ABCD	6943 BC
Domark	3 June	14.4 BC	50.9	1.18	211	32.9 BCD	6996 BC
Domark	Both	12.3 BC	52.1	1.37	204	33.4 BCD	6798 BC
Folicur	13 May	17.4 BC	49.1	1.42	206	32.0 CD	6592 C
Folicur	3 June	10.6 BC	48.6	1.26	205	37.4 AB	7645 ABC
Folicur	Both	9.6 BC	48.3	1.36	217	33.1 BCD	7163 BC
Headline + F	13 May	12.1 BC	47.7	1.32	221	33.0 BCD	7281 ABC
Headline + F	3 June	5.3 C	50.5	1.35	220	30.5 D	6706 C
Headline + F	Both	7.5 BC	44.7	1.30	191	35.1 ABC	6648 C
Quadris	13 May	14.5 BC	51.1	1.24	214	33.9 ABCD	7268 ABC
Quadris	3 June	12.2 BC	51.3	1.19	217	38.4 A	8334 A
Quadris	Both	5.1 C	48.3	1.50	209	31.8 CD	6628 C
Quilt	13 May	10.2 BC	44.4	1.36	208	31.7 CD	6584 C
Quilt	3 June	12.6 BC	50.5	1.36	216	35.4 ABC	7613 ABC
Quilt	Both	4.9 C	47.0	1.30	215	34.8 ABCD	7491 ABC
Tilt	13 May	11.6 BC	43.9	1.33	212	31.2 CD	6599 C
Tilt	3 June	10.7 BC	49.3	1.43	205	33.9 BCD	6905 BC
Tilt	Both	14.2 BC	47.5	1.19	206	33.3 BCD	6864 BC
Q + F + T	Both	6.6 C	48.9	1.21	219	35.7 ABC	7823 AB

Values within a column followed by the same letter were not significantly different (P=0.1).

Table 6. Effect of fungicides on established brown rust in LCP 85-384, Iberia Parish, 2005.

Fungicide treatment	Percent rust in July	Stalks/acre (x 1,000)
None	36.9	53.2
Domark	43.8	52.1
Folicur	36.5	55.8
Headline + Folicur	31.3	52.9
Quadris	45.6	53.9
Quilt	43.2	54.7
Tilt	40.1	51.8
Folicur + Quadris + Tilt	34.2	54.9

Conclusions:

A significant yield loss due to rust was again demonstrated in LCP 85-384. Rust is clearly a factor limiting LCP 85-384 yield, particularly in the southern areas of the industry. The magnitude of the potential yield loss suggests that a fungicide control program might be feasible. It is uncertain which components of the three fungicide combination treatment employed in the yield loss studies were effective in controlling rust or how many times they would need to be applied to be effective. However, Folicur and Tilt have the same mode of action, and fungicides of this type are now commercially available in combination with fungicides, such as Quadris, with a different mode of action. An encouraging outcome from the yield loss studies is that significant yield increases were obtained in 2004 and 2005 without applications to control the earliest stage of the spring epidemic. This could suggest that a high number of fungicide applications might not be necessary. However, a discouraging outcome was the failure to obtain a yield increase at one location during 2004. A large amount of money was spent on fungicides at this site without any benefit.

The 2005 experiments in which the different fungicides were evaluated separately and in combination and at different times of application did not provide conclusive evidence concerning the feasibility of an on-farm fungicide control program for rust. It appears that these fungicides possess the ability to reduce rust severity, either singly or in combination. However, they did not significantly increase yield, and they were not capable of stopping a rust epidemic that had already become severe.

YELLOW LEAF

The Sugarcane Disease Detection Lab also monitored for *Sugarcane yellow leaf virus* (SCYLV) in the LSU AgCenter Variety Selection Program, the ASCL Variety Release Program, and Sugartek® (Helena Chemical Co.) and Kleentek® seedcane sources (Table 7). A total of 12,448 samples were tested. Commercial tissue culture seedcane sources were tested for the second season as part of the Louisiana Department of Agriculture Seedcane Certification Program. No field failed to certify due to virus infection.

Table 7. Sugarcane yellow leaf virus testing summary for 2005.

Source	Location	No. of fields	No. of varieties	No. of samples
LSUAC	St. Gabriel & Iberia	-	14	337
Variety Release Program	1° & 2° stations	-	12	380
Helena	Foundation stock	-	8	28
Helena	Increase farms	34	2	1088
Kleentek®	Foundation stock	-	25	112
Kleentek®	1° increase farms	74	8	2487
Kleentek®	2° increase farms	92	4	3299
Local Quarantine	LSUAC	-	16	135
Research	LSUAC	-	-	4582
Totals		200		12,448

A field experiment was conducted at the St. Gabriel Research Station to evaluate the yield loss caused by SCYLV infection in HoCP 96-540. Yield components were compared in completely virus-infected and nearly virus-free plots. In plantcane, virus infection was found to cause reductions of 13% in both cane tonnage and sucrose per acre yields.

Table 8. Effect of *Sugarcane yellow leaf virus* (SCYLV) infection on plantcane yield components of HoCP 96-540.

Treatment	Stalks/acre	Stalk wt. (lbs.)	Sugar/ton (lbs.)	Tons of cane per acre	Sugar/acre (lbs.)
SCYLV -	40,763	2.3	211	43.1 A	9087 A
SCYLV +	38,987	2.1	211	37.6 B	7948 B

Values within columns followed by different letters were significantly different (P=0.05).

ROOT DISEASES

A soil applied pesticide, AgriTerra, was evaluated in a field experiment at the St. Gabriel Research Station for the potential to reduce plant parasitic nematode populations and increase yield of LCP 85-384. All AgriTerra treatments reduced spring, summer and end of season nematode populations (Table 9). The ranking of the treatments was the same for the spring and summer populations. The 1:100 dilution applied either at planting or with fertilizer in the spring was more effective in reducing nematode numbers than the 1:200 dilution applied at planting and with fertilizer. At the end of the season, nematode numbers had increased in the single at-planting treatment, but the population was still lower than in the non-treated treatment.

Sugarcane stalks per acre and individual stalk weight were numerically slightly higher for the AgriTerra treatments but not significantly different than the non-treated control (Table 10). Differences were detected among treatments in sucrose content of the stalks (sugar per ton of cane). Cane tonnage and sucrose per acre were determined two ways. When the individual stalk yield components were used to estimate the tons of cane and pounds of sucrose produced per acre, the values for the AgriTerra treatments were numerically higher but not significantly different than the non-treated control (Table 10). The increased amounts in sugar per acre would be economically significant to a farmer. However, the differences among treatments were not detected when cane tonnage was determined by a different method in which the weight of the total amount of cane passing through the harvester into the wagon was recorded for each plot (Table 11).

Table 9. Effects of AgriTerra on spring, summer and end of season nematode populations in a plantcane field of sugarcane variety LCP 85-384 during 2005.

Treatment	Nematodes/lb. of soil 23 May	Nematodes/lb. of soil 18 August	Nematodes/lb. of soil 8 December
Non-treated control	30,984 A	41,179 A	5,515 A
AgriTerra 1:100 at planting	3,727 C	4,202 C	1,030 B
AgriTerra 1:100 with spring fertilizer	4,305 C	4,531 C	761 BC
AgriTerra 1:100 at planting and spring fertilization	11,315 BC	12,863 BC	601 BC
AgriTerra 1:200 at planting and spring fertilization	19,560 B	22,580 B	216 C

Values within a column followed by the same letter were not significantly different (P=0.05).

Table 10. Effects of AgriTerra on plantcane crop yield components of sugarcane variety LCP 85-384 (cane tonnage and sugar per acre estimated from stalk counts, stalk weight, and sugar /ton).

Treatment	Stalks/acre (x1000)	Stalk weight (lbs.)	Sugar/ton (lbs.)	Cane/acre (tons)	Sugar/acre (lbs.)
Non-treated control	56.1	1.41	218.9 AB	39.6	8,663
AgriTerra 1:100 at planting	56.5	1.56	228.0 A	44.2	10,068
AgriTerra 1:100 with spring fertilizer	56.8	1.45	220.6 AB	41.2	9,141
AgriTerra 1:100 at planting and spring fertilization	54.8	1.49	226.3 A	40.8	9,210
AgriTerra 1:200 at planting and spring fertilization	56.4	1.56	210.8 B	43.8	9,240

Values within a column followed by the same letter were not significantly different (P=0.05).

Table 11. Effects of AgriTerra on sugarcane plantcane yield components of sugarcane variety LCP 85-384 (cane tonnage and sugar/acre determined from actual harvested cane weight).

Treatment	Stalks/acre (x1000)	Stalk weight (lbs.)	Sugar/ton (lbs.)	Cane/acre (tons)	Sugar/acre (lbs.)
Non-treated control	56.1	1.41	218.9 AB	38.4	8,414
AgriTerra 1:100 at planting	56.5	1.56	228.0 A	37.2	8,489
AgriTerra 1:100 with spring fertilizer	56.8	1.45	220.6 AB	37.8	8,340
AgriTerra 1:100 at planting and spring fertilization	54.8	1.49	226.3 A	36.6	8,274
AgriTerra 1:200 at planting and spring fertilization	56.4	1.56	210.8 B	39.1	8,232

Values within a column followed by the same letter were not significantly different (P=0.05).