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 2014 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, evaluating changes in the soil microbial community associated with long-term sugarcane cultivation, and billet planting. Research results on billet planting are reported separately.

BROWN RUST

A cold winter followed by a cold spring resulted in no rust epidemic during 2013. A field experiment was conducted at the Sugar Research Station at St. Gabriel to evaluate the effect of fungicides and nickel (Ni) on plant growth in the absence of brown rust.

Fungicides and nickel (Manniplex, Brandt Consolidated) were applied to foliage two times 25 days apart, and leaf samples were collected 19 days after the second application for leaf tissue nutrient analysis. Ni uptake was evident with average Ni (ppm) tissue levels of 0.1 for the non-treated control, 11.2 for the 1 qt/acre treatment, 11.1 for the 1 qt/acre + Headline fungicide treatment, and 22.2 for the 2 qt/acre treatment. However, no differences were detected among all treatments for stalk population, stalk weight, sucrose per ton of cane, cane tonnage, or total sucrose yield (Table 1).

Table 1. Effects of fungicide and nickel applications in the absence of brown rust on yield components of HoCP 96-540 plant cane in a Sugar Research Station experiment during 2014.

Treatment[1]	Stalks/acre	Stalk weight (lbs.)	Sugar/ton (lbs.)	Tons cane/acre	Sugar/acre (lbs.)
Non-treated control	44,685	2.6	205	56.4	11,528
Headline SC 9 oz/acre	44,337	2.5	193	54.6	10,531
Priaxor 6 oz/acre	43,849	2.5	201	53.5	10,765
Priaxor 9 oz/acre	42,559	2.5	202	52.6	10,596
Manniplex Ni 1 qt/acre	42,873	2.4	207	56.0	11,607
Manniplex Ni 2 qt/acre	40,956	2.8	209	50.7	10,615
Headline SC 9 oz/acre + Manniplex Ni 1 qt/acre	43,744	2.6	203	55.8	11,302

[1]Nickel and fungicides were foliarly applied two times on 6/6/14 and 7/2/14. No differences were detected for yield component means within columns ($P = 0.05$).

Research is on-going to develop molecular markers for brown rust resistance in cooperation with Dr. Niranjan Baisakh. Molecular mapping has been initiated with 187 self progeny of L 99-233 and its progenitors. An attempt to phenotype the L 99-233 self population by natural infection severity was not successful to the lack of a brown rust epidemic during 2014. Bulk segregant analysis to associate markers with resistance based on controlled conditions inoculation is in progress.

ORANGE RUST DURING 2014

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. Increase plots of this variety still remain on the secondary increase stations for the American Sugar Cane League Variety Release Program. Orange rust was observed at some of these locations late in the growing season. Orange rust also was observed in a few fields of CP 89-2143.

HEALTHY SEEDCANE PROGRAM SUPPORT

Disease testing was conducted by the Sugarcane Disease Detection Lab for the 19th year during 2014. Kleentek and SugarTech seedcane production was monitored for ratoon stunting disease (RSD), and no disease was detected (Table 2). A total of 3,112 stalk samples from research farms, variety increase plots, and grower fields were tested for RSD with no positives detected (Table 2). Limited testing was conducted on commercial farms; no RSD was detected in 50 sampled fields (Table 3). A total of 6,021 leaf samples were tested for yellow leaf (Table 4). 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.

Table 2. RSD testing summary for 2014.

Source	Location	No. of fields	No. of varieties	No. of samples
Louisiana growers	State-wide	50	10	1,010
Variety Release Program	1° & 2° stations	-	24	1,378
Helena SugarTech®	Foundation stock	-	-	-
Kleentek®	Foundation stock	-	-	76
Kleentek®	Other than foundation	-	-	586
Local Quarantine	LSUAC	-	11	58
Research	LSUAC	-	-	4
Totals		50	45	3,112

Table 3. RSD field and stalk infection frequencies in different crop cycle years for all varieties combined during 2014.

Crop Year	Total number of fields	Average field infection (%)	Total number of stalks	Average stalk infection (%)
Plant cane	6	0	115	0
First stubble	8	0	151	0
Second stubble	18	0	375	0
Older stubble	18	0	369	0
Totals/Averages	50	0	1,010	0

Table 4. Sugarcane yellow leaf virus testing summary for 2014.

Source	Location	No. of fields	No. of varieties	No. of samples
LDAF	Seed Certification	157	-	4,530
Helena SugarTech®	Foundation stock	-	-	-
Kleentek®	Foundation stock	-	-	-
Kleentek®	Other than foundation	-	-	1,333
Local Quarantine	LSUAC	-	11	58
Research	LSUAC	-	-	100
Totals		157	11	6,021

RESISTANCE TO LEAF SCALD

The primary control measure for leaf scald is host plant resistance. Currently, resistance is evaluated by visually rating disease severity in an annual inoculated test (Table 5). Resistance ratings 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 correlation was determined for the second time between visual ratings based on systemic symptom severity and bacterial population determined by qPCR during 2014 (Table 5). The Spearman's rank correlation coefficient was low (0.28, $P = 0.0127$), and little bacterial amplification occurred with the susceptible check variety, HoCP 89-846. The results suggest further study is needed on factors affecting the PCR quantification of leaf scald bacteria.

Research is on-going to develop molecular markers for leaf scald resistance in cooperation with Dr. Niranjan Baisakh. Marker association and molecular mapping has been initiated with 200 clones from a cross between LCP 85-384 (resistant) and L 99-226 (susceptible).

Table 5. Leaf scald resistance ratings determined in an inoculated test by severity of visual symptoms or polymerase chain reaction assay for commercial and experimental sugarcane varieties during 2014.

Variety	Leaf scald visual rating[1]	RT-PCR rating[1]	Variety	Leaf scald visual rating[1]	RT-PCR rating[1]
L 01-040	2	2	L 12-197	3	1
L 01-299	5	2	L 12-198	2	1
HoCP 07-613	7	5	L 12-199	6	4
L 09-112	2	1	L 12-201	6	1
HoCP 09-804	2	1	L 12-202	4	1
HoCP 09-840	6	1	L 12-218	1	1
L 10-937	2	3	L 12-227	5	3
L 11-168	3	6	L 12-229	3	1
L 11-172	3	1	L 12-230	5	2
L 11-183	3	2	L 12-232	6	2
L 11-187	4	4	CP 73-351	4	1
L 11-191	3	3	HoCP 89-846	5	1
L 12-193	2	1	N27	3	1

[1]Resistance ratings assigned on a 1-9 scale in which 1-3 = resistant, 4-6 = moderately susceptible, and 7-9 = highly susceptible. RT-PCR = real-time polymerase chain reaction.

EVALUATING DISEASE RESISTANCE IN THE VARIETY SELECTION PROGRAM

Resistance to smut was evaluated for experimental varieties in the Variety Selection Program in an annual inoculated test at the Sugar Research Station, and a range of resistance was detected among the clones (Table 6). In addition, a study to develop potential parents with resistance to smut and leaf scald was completed. Two hundred clones from the line trials were inoculated with smut twice. In the first inoculation, 34% of the clones did not develop any smut infection. In a second inoculation, 20 of 68 (29%) of the clones developed smut infection. The population also was inoculated with leaf scald. Four clones were identified with resistance to both diseases.

SOIL MICROBIAL COMMUNITIES ASSOCIATED WITH LONG-TERM CANE CULTIVATION

Growers have often observed increased growth and yield for cane planted in “new ground” or soils without a recent sugarcane planting history. A study was initiated with Dr. Lisa Fultz during 2014 to compare the soil and root associated microbial communities in soils with and without a long-term sugarcane cropping history. Three paired sites of fields of plant cane of the same variety in similar soils with and without a long-term sugarcane cropping history were identified, and bulk and rhizosphere soil samples were collected. Comparisons are being made for soil nutrients, soil enzymatic activities, fatty acid ester (FAME) profiles, and total bacterial and fungal community make-ups based on next generation DNA sequencing. A second trio of paired sites have been identified and will be evaluated during 2015.

Soil nutrients varied between sites, but consistent differences between “new” and “old” cane land were not detected. No consistent patterns were detected for soil enzyme activity.

FAME biomarkers distinguished microbial communities in “new” and “old” fields. Old fields were dominated by bacterial communities, whereas fungi predominated in new fields for two of three paired sites.

Table 6. Smut inoculation test infection percentage means and resistance ratings for 2014.

Variety	Infection mean (%)	Rating[1]	Variety	Infection mean (%)	Rating[1]
CP 73-351	51	9	L 11-191	0	1
LCP 85-384	15	5	L 12-193	25	6
HoCP 89-846	9	4	L 12-197	0	1
L 01-040	3	2	L 12-198	0	1
L 01-299	85	9	L 12-199	41	8
HoCP 07-613	0	1	L 12-201	0	1
L 09-112	0	1	L 12-202	22	6
HoCP 09-804	12	4	L 12-218	33	7
HoCP 09-840	0	1	L 12-227	17	5
Ho 10-937	0	1	L 12-229	1	2
L 11-168	0	1	L 12-230	27	6
L 11-172	1	2	L 12-232	35	7
L 11-183	0	1	N27	0	1
L 11-187	0	1			

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