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 2015 included brown rust resistance evaluation, support of healthy seedcane programs to manage ratoon stunting and other systemic diseases, 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

Winter and spring weather conditions resulted in little or no brown rust during Spring 2015. This limited brown rust research opportunities. Screening methods to evaluate resistance to brown rust under controlled conditions were used to characterize a L 99-233 self population for brown rust resistance. An attempt to phenotype the L 99-233 self population by natural infection severity should provide results from two plantings during 2016. L 99-233 exhibits low infection levels regardless of brown rust pathogen isolate used for inoculation suggesting it has a type of resistance that could be more durable.

Research is on-going to develop molecular markers for brown rust resistance in cooperation with Dr. Niranjan Baisakh. Genotyping by sequencing has been initiated with clones from the L 99-233 self population exhibiting resistance or susceptibility to brown rust. Linkage mapping has been initiated with the self progeny of L 99-233 and its progenitors. A differential gene expression study has been conducted in cooperation with N. Baisakh focusing on the brown rust resistance response of L 99-233. Molecular markers for the major brown rust resistance gene *Bru*1 were used to determine the distribution and frequency of this gene in the USDA-ARS World Collection of Sugarcane and Related Grasses. All these results are reported separately.

ORANGE RUST DURING 2015

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 some secondary increase stations for the American Sugar Cane League Variety Release Program. Due to unfavorable winter environmental conditions, orange rust was not observed during 2015. Surveys for orange rust will continue during 2016.

HEALTHY SEEDCANE PROGRAM SUPPORT

Disease testing was conducted by the Sugarcane Disease Detection Lab for the 20th year during 2015. Kleentek and SugarTech seedcane production was monitored for ratoon stunting disease (RSD), and no disease was detected (Table 1). A total of 3,531 stalk samples from research

farms, variety increase plots, and grower fields were tested for RSD with no positives detected. The Local Quarantine supplied healthy plant material of promising experimental varieties to the two seedcane companies to establish Foundation Stock plants that will provide apical meristems for tissue culture. Limited testing was conducted on commercial farms, and no RSD was detected in 50 sampled fields (Table 2). A total of 6,454 leaf samples were tested for *Sugarcane yellow leaf virus* (Table 3). Commercial tissue-culture seedcane sources were tested as part of the LDAF seedcane certification program. No field failed to certify due to virus infection.

Table 1. Ratoon stunting disease testing summary for 2015.

Source	Location	No. of fields	No. of varieties	No. of samples
Louisiana growers	State-wide	50	8	1,053
Variety Release Program	1° & 2° stations	-	27	1,647
Helena SugarTech®	Foundation stock	-	-	-
Kleentek®	Foundation stock	-	-	74
Kleentek®	Other than foundation	-	-	665
Local Quarantine	LSUAC	-	20	92
Research	LSUAC	-	-	-
Totals		50	55	3,531

Table 2. Ratoon stunting disease field and stalk infection testing results in different crop cycle years for all varieties combined during 2015.

Crop year	Total number of fields	Average field infection (%)	Total number of stalks	Average stalk infection (%)
Plant cane	9	0	178	0
First stubble	13	0	261	0
Second stubble	13	0	359	0
Older stubble	15	0	255	0
Totals/Averages	50	0	1,053	0

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 a breeding program annual inoculated test. Research is on-going to develop molecular markers for leaf scald resistance in cooperation with Dr. Niranjan Baisakh. Molecular marker association and linkage mapping is in progress with 200 clones that are progeny from a cross between LCP 85-384 (resistant) and L 99-226 (susceptible).

Table 3. Sugarcane yellow leaf virus testing summary for 2015.

Source	Location/type	No. of fields	No. of varieties	No. of samples
LDAF	Seed Certification	170	-	4,948
Helena SugarTech®	Foundation Stock	-	-	-
Kleentek®	Foundation Stock	-	-	-
Kleentek®	Other than foundation	-	-	1,295
Local Quarantine	LSUAC	-	20	92
Research	LSUAC	-	-	119
Totals		170	20	6,454

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 4). The same selection population was inoculated and evaluated for resistance to leaf scald, and a range of resistance was detected (Table 5). 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, and these will be used as parents in the breeding program.

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. During 2015, 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 during June. Comparisons are being made for soil nutrients, soil enzymatic activities, fatty acid methyl ester (FAME) profiles, and total bacterial and fungal community make-ups based on next generation DNA sequencing.

Characterization of soil microbial communities from the 2015 sites using taxonomically broad FAME biomarkers revealed differences between the new and old ground microbial communities in both bulk and root associated soils with communities associated with long-term sugarcane cultivation containing proportionally more bacterial taxa. A greenhouse experiment using field soils from the 2014 paired sites was not able to fully capture growth differences. However, yield

estimates determined in the field for the 2015 sites revealed significantly higher yields in soils without prior sugarcane cultivation compared to long-term cultivation (Table 6).

Expanded testing of soil nutrients of both 2014 and 2015 paired site bulk soils revealed that sodium, sulfur, salts, iron, and soil organic matter were significantly greater in the soils without prior sugarcane cultivation for at least half of all paired sites tested. Presently, data from a next generation sequencing experiment is being processed in order to classify the species, genera, and families of bacteria and fungi present in soils from the paired sites that may help explain the differences in sugarcane growth and yield.

Table 4. Smut infection means and resistance ratings determined in an inoculated test for commercial and experimental sugarcane varieties during 2015.

Variety	Mean infection (%)	Rating[a]	Variety	Mean infection (%)	Rating[a]
CP 73-351	38	8	L 11-187	0	1
LCP 85-384	8	3	Ho 11-511	0	1
CP 89-846	8	3	Ho 11-515	0	1
CP 95-2287	0	1	Ho 11-532	6	3
HoCP 96-540	0	1	Ho 11-556	13	4
CP 96-1252	6	3	L 12-201	0	1
CP 97-2730	0	1	L 12-202	0	2
L 99-226	5	3	L 12-227	23	6
CP 99-4455	53	9	L 13-234	0	1
CP 00-1101	0	1	L 13-236	49	9
CP 00-4111	4	2	L 13-240	15	5
L 01-299	72	9	L 13-241	0	1
CP 01-1372	35	8	L 13-242	0	1
L 02-926	2	2	L 13-243	0	1
CP 02-1295	0	1	L 13-245	0	1
CP 03-1912	26	6	L 13-246	0	1
CP 04-1566	0	1	L 13-250	2	2
CP 04-1844	0	1	L 13-251	0	1
CP 04-1935	0	1	L 13-254	5	3
Ho 07-613	0	1	L 13-256	0	1
HoCP 09-804	0	1	L 13-257	0	1
Ho 09-840	5	3	L 13-258	0	1
L 10-147	1	2	L 13-259	23	6
L 11-168	2	2	L 13-260	0	1
L 11-172	0	1	L 13-263	0	1
L 11-183	0	1			

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

Table 5. Leaf scald resistance ratings determined in an inoculated test for commercial and experimental sugarcane varieties during 2015.

Variety	Visual severity rating[a]	Variety	Visual severity rating[a]
CP 73-351	2	L 11-187	2
LCP 85-384	4	Ho 11-511	5
CP 89-846	6	Ho 11-515	7
CP 95-2287	1	Ho 11-532	5
HoCP 96-540	8	Ho 11-556	8
CP 96-1252	1	L 12-201	4
CP 97-2730	4	L 12-202	6
L 99-226	5	L 12-227	7
CP 99-4455	1	L 13-234	6
CP 00-1101	1	L 13-236	2
CP 00-4111	2	L 13-240	5
L 01-299	2	L 13-241	6
CP 01-1372	2	L 13-242	2
L 02-926	4	L 13-243	7
CP 02-1295	3	L 13-245	9
CP 03-1912	4	L 13-246	8
CP 04-1566	1	L 13-250	6
CP 04-1844	3	L 13-251	7
CP 04-1935	1	L 13-254	2
Ho 07-613	6	L 13-256	2
HoCP 09-804	6	L 13-257	4
Ho 09-840	6	L 13-258	1
L 10-147	5	L 13-259	2
L 11-168	1	L 13-260	6
L 11-172	3	L 13-263	7
L 11-183	2		

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

Table 6. Yield components for plant cane at three paired sites comparing soils with a long-term sugarcane cultivation history (old cane) to soils with no recent history of sugarcane cultivation (new cane) during 2015.

Paired site location (Variety)	Cropping history	Stalk weight (lbs)[a]	Sucrose per ton of cane (lbs)[a]	Stalk population (x1,000)[a]	Tons of cane per acre[a]	Sucrose per acre (lbs)[a]
Iberia Station (HoCP 96-540)	New cane	1.6*	170	52.3*	41.2*	6,960*
	Old cane	1.2	165	42.4	25.4	4,193
Gonsoulin farm (HoCP 96-540)	New cane	2.4*	188*	42.5*	45.0*	7,606*
	Old cane	1.8	168	38.1	37.2	6,974
Sugar Station (L 01-299)	New cane	2.8*	165*	51.0*	70.6*	9,897*
	Old cane	2.1	141	44.2	46.1	7,625

[a]Mean values followed by an asterisk (*) within a column were significantly higher than the mean for the other paired field at the same location.