PATHOLOGY RESEARCH

Jeffrey W. Hoy[1], Carolyn F. Savario[1], Raghuwinder Singh[1], Jose David Cortes[1], and Chenie Zamora[1]

[1]Department of Plant Pathology and Crop Physiology

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 during 2020 included screening for resistance to multiple diseases; generating phenotypic data for developing and validating molecular markers for resistance to mosaic, brown rust, and smut; providing support for healthy seedcane programs to manage systemic diseases; managing brown rust with fungicides; and billet planting. Research results on billet planting are reported separately.

Mosaic Resistance Evaluation

A project addressing mosaic, a historically important disease for the Louisiana sugarcane industry, was continued during 2020. The goal of all of the recent mosaic research is to prevent it from re-emerging as a problem for the industry. An ongoing component of the project has been to evaluate resistance to mosaic for breeding program parents by utilizing mechanical inoculation of young plants grown in the greenhouse. Beginning in 2017, the parent populations of the commercial and basic breeding programs were screened for resistance, and mosaic inoculation has been reinstituted as a component of the breeding program.

Mosaic is spread from plant to plant by aphids. Therefore, monitoring natural spread by aphids has been included as an additional aspect of screening for resistance to mosaic in the variety selection program. This is done by planting 'spreader rows' of mosaic infected cane between rows containing plots of experimental varieties in the last stages of the selection program that have been inoculated with smut and leaf scald (see smut and leaf scald inoculated test results below) then monitoring plots for naturally infected plants during the season. During 2020, natural infection by mosaic was detected in 10 of 50 (20%) of experimental varieties.

Phenotypic Data for Developing and Validating Molecular Markers for Disease Resistance

Results are being obtained for resistance reactions (phenotypes) of clone populations selected for association and validation of molecular markers for resistance to multiple diseases, including mosaic, brown rust, and smut, in studies being conducted in cooperation with Dr. Niranjan Baisakh. All of the parents with consistent mosaic inoculation results from the commercial and basic parent populations are serving as an initial resistance marker association population. During 2020, 253 clones from a biparental cross between mosaic resistant and susceptible parents (HoCP 15-915 susceptible x HoCP 96-540 resistant) were mechanically inoculated with mosaic twice, and a range of resistance phenotypes were detected (Table 1). In the first inoculation experiment, 46% of the clones had a resistant phenotype and 54% had a susceptible phenotype. In the second inoculation, 43% had a resistant phenotype and 57% had a susceptible phenotype. There were 61 of 253 clones (24%) that had variable results between the

two experiments. The results from clones in the population with consistent reactions will be used to validate the molecular markers for resistance developed from the parent populations.

Table 1. Mosaic mechanical inoculation results for clones in a biparental population (HoCP 14-951 susceptible x HoCP 96-540 resistant) from two experiments conducted at the USDA Sugarcane Research Unit during 2020

	HR	MR	MS	S	HS	Missing	Total
Inoculation 1	91	24	9	20	107	2	253
Inoculation 2	90	18	19	42	84	0	253

Resistance responses determined from six inoculated plants per clone with HR = highly resistant (0% infection), MR = moderately resistant (1-24%), MS = moderately susceptible (25-49%), S = susceptible (50-74%), HS = highly susceptible (75-100%).

Natural infection levels were adequate to assign brown rust resistance ratings to a biparental cross population (L 99-233 resistant x HoCP 96-540 susceptible). These results are being used with previously obtained natural infection results to associate molecular markers with resistance to brown rust. The same biparental population with reversed ratings (L 99-233 susceptible x HoCP 96-540 resistant) was successfully screened for resistance to smut in a second inoculated field experiment during 2020. Clones of the population were dip-inoculated with smut spores and planted at the Sugar Research Station. The results are being used to associate molecular markers with resistance to smut.

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 2). The same selection population was inoculated and evaluated for resistance to leaf scald, and a range of resistance was detected (Table 3).

Evaluation of Fungicide Efficacy for Brown Rust Control

During 2020, a strip trial was conducted on a commercial farm in Iberville Parish to compare the efficacy of two fungicides, Priaxor (fluxapyroxad 14.3% and pyraclostrobin 28.6%; 7 oz/acre rate; BASF) and Trivapro (benzovindiflupyr 2.9%, azoxystrobin 10.5%, propiconazole 11.9%; 13.7 oz/acre rate; Syngenta). Three replicates of six entire rows of rust susceptible variety L 01-283 were treated twice with each fungicide or left untreated. Application dates were 4/17/2020 and 5/13/2020. The first application was applied on a 54-inch band, and the second application was broadcast. Top visible dewlap leaves were collected 5/4/2020 and assessed by image analysis for percent leaf area occupied by rust lesions. Both fungicides reduced rust severity by similar amounts. The non-treated check, Priaxor, and Trivapro leaves had mean leaf infection percentages of 2.2, 0.9, and 0.7%, respectively. The experiment was designed to have one truckload of cane harvested from each replicate of six rows and sent to the mill with a harvest date of 12/20/2020. Both fungicides did not affect sugar and fiber traits but increased cane yield compared to non-treated cane (Table 4).

Table 2. Smut infection means and resistance ratings determined in an inoculated test for commercial check and experimental sugarcane varieties during 2020

Variety	Mean infection (%)	Rating[1]	Variety	Mean infection (%)	Rating[1]
CP 73-351	10	4	L 17-435	13	4
CP 89-846	11	4	Ho 17-701	1	2
HoCP 96-540	3	2	Ho 17-702	3	2
L 01-299	6	3	Ho 17-705	0	1
Ho 04-838	10	4	Ho 17-710	1	2
09-804	8	4	Ho 17-714	0	1
L 11-183	0	1	Ho 17-716	2	2
L 12-201	0	2	Ho 17-724	0	2
Ho 12-615	0	1	Ho 17-725	3	2
Ho 12-630	0	1	Ho 17-738	7	3
Ho 13-739	0	1	Ho 17-755	0	1
L 14-267	0	2	Ho 17-756	6	3
Ho 14-885	0	1	L 18-438	4	2
L 15-306	0	1	L 18-439	0	1
Ho 15-508	25	6	L 18-441	11	4
Ho 15-971	0	1	L 18-443	0	1
Ho 16-600	2	2	L 18-450	0	1
Ho 16-608	2	2	L 18-451	0	1
Ho 16-626	0	1	L 18-452	33	7
Ho 16-647	1	2	L 18-453	60	9
Ho 16-675	16	5	L 18-455	44	9
Ho 16-678	14	4	L 18-458	29	6
Ho 16-680	0	1	L 18-460	0	1
L 17-398	0	1	L 18-468	20	5
L 17-400	3	2	L 18-469	18	5
L 17-405	1	2	L 18-471	1	2
L 17-410	10	4	L 18-472	4	2
L 17-419	2	2	L 18-474	12	4
L 17-424	4	2	L 18-475	32	7
L 17-426	9	4	L 18-477	0	1
L 17-428	17	5			

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

Table 3. Leaf scald resistance ratings determined in an inoculated test for commercial check and experimental sugarcane varieties during 2020

Variety	Visual severity rating[1]	Variety	Visual severity rating[1]
CP 73-351	9.0	L 17-435	4.7
CP 89-846	4.1	Ho 17-701	3.6
HoCP 96-540	3.5	Ho 17-702	6.1
L 01-299	7.4	Ho 17-705	5.4
Ho 04-838	5.5	Ho 17-710	6.9
HoCP 09-804	3.3	Ho 17-714	6.8
L 11-183	3.3	Ho 17-716	6.1
L 12-201	1.4	Ho 17-724	3.8
Ho 12-615	6.9	Ho 17-725	7.4
Ho 12-630	3.8	Ho 17-738	4.5
Ho 13-739	4.0	Ho 17-755	4.8
L 14-267	2.7	Ho 17-756	3.3
Ho 14-885	4.8	L 18-438	4.8
L 15-306	2.0	L 18-439	8.4
Ho 15-508	5.5	L 18-441	5.7
Ho 15-971	6.4	L 18-443	2.0
Ho 16-600	5.7	L 18-450	4.7
Ho 16-608	5.7	L 18-451	3.1
Ho 16-626	3.3	L 18-452	4.4
Ho 16-647	6.8	L 18-453	5.9
Ho 16-675	5.4	L 18-455	8.1
Ho 16-678	4.9	L 18-458	4.4
Ho 16-680	1.7	L 18-460	3.3
L 17-398	7.8	L 18-468	5.0
L 17-400	6.7	L 18-469	7.7
L 17-405	8.8	L 18-471	6.5
L 17-410	5.9	L 18-472	8.9
L 17-419	1.9	L 18-474	2.0
L 17-424	4.3	L 18-475	5.7
L 17-426	5.1	L 18-477	4.4
L 17-428	5.1		

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

Table 4. Effects of two fungicides, Priaxor and Trivapro, on plant cane yield components of L 01-283 infected by brown rust in a strip trial conducted in Iberville Parish during 2020

Treatment	CRS[1]	Tons of cane per acre[1]	Sugar per acre (lbs) [1]
Non-treated	252.3 a	37.6 b	9,477.8 a
Priaxor	246.9 a	41.5 a	10,262.5 a
Trivapro	246.8 a	41.1 a	10,148.5 a

[1]Means within a column followed by the same letter were not significantly different (P>0.05).

Healthy Seedcane Program Support

Disease testing was conducted by the Sugarcane Disease Detection Lab for the 25th year during 2020. Kleentek and SugarTech seedcane production was monitored for ratoon stunting disease (RSD), and no disease was detected (Tables 5 and 6). A total of 2,353 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 active experimental varieties from the 2016 series 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 20 sampled fields. A total of 8,689 leaf samples were tested for Sugarcane yellow leaf virus as part of the LDAF Sugarcane Seed Certification Program (Table 7). One field failed to certify due to virus infection.

Table 5. RSD testing summary for 2020

Source	Location	No. of fields	No. of varieties	No. of samples
Louisiana growers	State-wide	20	2	561
Variety Release Program	1° & 2° stations	-	2	126
Helena SugarTech®	Foundation stock	-	-	-
Kleentek®	Foundation stock	-	-	218
Kleentek®	Other than foundation	-	-	131
Local Quarantine	LSUAC	-	19	57
Research	LSUAC	-	-	1260
Totals		20	23	2,353

Table 6. RSD commercial field and stalk infection frequencies in different crop cycle years for all varieties combined during 2020

Crop Year	Total number of fields	Average field infection (%)	Total number of stalks	Average stalk infection (%)
Plant cane	0	0	0	0
First stubble	0	0	0	0
Second stubble	5	0	142	0
Older stubble	15	0	419	0
Totals/Averages	20	0	561	0

Table 7. Sugarcane yellow leaf virus testing summary for 2020

Source	Location	No. of fields	No. of varieties	No. of samples
LDAF	Seed Certification	244	-	7346
Helena SugarTech®	Foundation stock	-	-	-
Kleentek®	Foundation stock	-	-	90
Kleentek®	Other than foundation	-	-	895
Local Quarantine	LSUAC	-	19	57
Research	LSUAC	-	-	301
Totals		244	19	8,689