PATHOLOGY RESEARCH

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Pathology research addresses the important diseases affecting sugarcane in Louisiana. The overall program goal is to minimize losses to diseases in the most cost-effective manner possible. Projects receiving major emphasis during 2001 were ratoon stunting disease (RSD) management; assessing the threat posed by our newest disease, sugarcane yellow leaf; improving our understanding of root disease; and breeding and selecting disease-resistant varieties. Stalk rot research is a component of research on billet planting reported separately.

RATOON STUNTING DISEASE

A fifth year of testing for RSD was conducted during 2001 as part of the Sugarcane Disease Detection Lab operations. RSD was monitored in fields on commercial farms, in the LAES Variety Selection program, in the American Sugar Cane League Variety Release Program, in the local quarantine described below, and at all levels of Kleentek® seedcane production (Table 1). In 1997, the first year of on-farm testing, the infection levels considered as number of farms with RSD detected in at least one field, the frequency of fields with RSD-infected cane across the entire industry, and the frequency of stalks with RSD within fields averaged 83, 51, and 12%, respectively. By 2000, these statistics had decreased to 35, 14, and 2%, respectively, and the numbers decreased again in 2001, when the averages were 16, 7, and less than 1%, respectively. RSD incidence no longer exhibits a typical pattern for a mechanically spread disease, in which infection levels increase progressively with more harvests and higher levels of disease are detected in stubble crops. Instead, detected RSD incidence was low for sampled fields in all years of the crop cycle (Table 2).

This steadily decreasing incidence of disease represents a major positive development for the industry. Factors associated with decreasing RSD incidence over this period have been use of healthy seedcane produced through micropropagation and widespread planting of LCP 85-384, a variety with some resistance to the spread of RSD. The average percentage of fields with RSD detected was 5.4% for LCP 85-384 during 2001, and the average stalk infection frequency was only 0.5%. With a continued effort to plant healthy seedcane of LCP 85-384, many growers are eliminating RSD from their farms. This will provide a great advantage in the future when high-yielding but RSD-susceptible varieties are released.

LOCAL QUARANTINE

Six promising experimental varieties, L 97-128, L 97-137, L 98-207, L 98-209, HoCP 97-606, and HoCP 97-609, were processed through the local quarantine to provide healthy plant material to establish foundation stock plants that will provide meristems for micropropagation of Kleentek® seedcane. Three stalks from different plants of each variety were tested for RSD, leaf scald, and sugarcane yellow leaf virus, soaked for 48 hours, heat-treated at 50 C for 3 hours, planted in a screened greenhouse, and observed for disease symptoms for 6 months. The greenhouse plants were then re-tested for the three diseases, stalk sections were given the long soak, long hot water treatment, and single-bud cuttings were released for planting.

SUGARCANE YELLOW LEAF

Sugarcane yellow leaf virus (SCYLV) is present in all areas of the state, and research is under way to determine the potential impact in LCP 85-384 under Louisiana conditions. A tissue-blot immunoassay using imprints from leaf mid-ribs was used in the Sugarcane Disease Detection Lab for the detection of SCYLV (Table 3). A total of 8,609 samples were run through the lab. Testing of Kleentek® seedcane sources detected the virus in some fields. There is no evidence yet that SCYLV poses a serious threat to LCP 85-384. The plant-cane yields from an experiment comparing plantings established with either infected or non-infected seedcane (conducted in cooperation with M. P. Grisham at the USDA/ARS Sugarcane Research Unit Ardoyne experimental farm) did not detect a significant yield loss in LCP 85-384 caused by infection. Nonetheless, when a problem was detected in a seedcane field, cane was not sold from that field, and sampling of seedcane fields will be continued.

A graduate student research project conducted by Chris McAllister under the supervision of T. E. Reagan and J. W. Hoy has been initiated to evaluate entomological and pathological aspects of sugarcane yellow leaf. One component will be a study of the distribution and rates of disease spread and increase. A survey of fields in multiple parishes, including Ascension, Iberia, Rapides, and St. Mary, detected the virus in 10 of 16 (63%) fields picked at random and sampled (approximately 50 leaves per field). The infection level within an infected field averaged 9% and ranged from 2-45%. However, infection levels as high as 65% were detected in stubble fields previously known to have diseased cane. The rate of disease increase from one season to the next in these fields ranged from none to nearly a four-fold increase. On average, the infection level doubled. Two plant-cane experiments were established at single locations in Iberville and Rapides parishes to study the initial occurrence, patterns of spread, and rates of disease increase during the growing season. This will be determined in plots consisting of a 12 x 12 grid of contiguous quadrats. Two additional plots will be established during spring 2002 in stubble fields known to be infected with SCYLV. Additional extensive survey work also is planned.

ROOT DISEASE

A basic research project is attempting to improve our understanding of the effects of soilborne pathogens and root disease on sugarcane productivity. Pythium root rot and nematodes are known to be constraints to sugarcane growth and yield. However, evidence suggests that long-term cultivation of sugarcane can result in the development of a total soil microbial community that is detrimental to cane growth. This can be seen in the "new ground" effect observed by many growers when they plant in soil that has no recent history of sugarcane cultivation. Methods have been developed that allow the separation of the total DNA from the microbial community in a soil sample and amplification of part of the genome that codes for ribosomal subunit. This DNA fragment may eventually be used to identify and compare microorganisms present in "new" and "old" cane soil communities. Differences have been detected in types of culturable microorganisms that are present and substrate utilization profiles. The hope is that an improved understanding of the effects of the total soil microbial community on cane root development will allow us to determine ways to manipulate or manage the community to promote root system health and improve plant growth.

Additional research during 2001 addressed the potential effects of a new group of herbicides, including Milestone, Spartan, and Valor, on root disease. This research was conducted by J. H. Daugrois, a visiting scientist, in cooperation with J. L. Griffin. Evidence from other crops has suggested that these herbicides might have the ability to induce a phenomenon known as systemic acquired resistance that can limit infection by pathogens and reduce disease severity. Field observations have suggested that slight unexplained sugarcane growth increases sometimes occurred in herbicide evaluation experiments, so this project was initiated to attempt to determine if these herbicides were having any effects on sugarcane root disease. It was determined that these herbicides are detrimental to growth of the organism that causes Pythium root rot in culture. However, no conclusive evidence was found in three greenhouse tests for reduced root rot severity or increased plant growth resulting from herbicide treatments. In a field experiment, one Spartan and one Valor treatment increased millable stalk population.

SELECTION OF DISEASE-RESISTANT VARIETIES

Experimental varieties in the selection program are screened and rated for resistance to mosaic, smut, and leaf scald. Natural mosaic infection levels were determined in breeding program outfield yield trials. Little infection was detected (Table 4). Two of eight experimental varieties showed a trace of infection, and HoCP 97-606 had an average mosaic infection level of 4.6% across all locations.

Smut resistance was evaluated in experimental varieties in an inoculated test in which stalks were dipped in a smut spore suspension, then planted during August 2000. Smut infection levels were determined during July 2001 and compared to infection levels in varieties with known resistance reactions. Within the experimental varieties, 17 (57%), 13 (33%), and 3 (10%) were rated as resistant, moderately susceptible, and highly susceptible, respectively (Table 5).

Leaf scald resistance was evaluated in the same population using the decapitation inoculation method, in which the shoot is cut above the growing point and lead scald bacteria are sprayed on the cut surface during early June. However, sufficient symptoms to allow evaluation were not produced by the inoculated plants.

Table 1. RSD testing summary for 2001.

Source	Location	No. of fields	No. of varieties	No. of stalks
Louisiana growers	Statewide	276	5	5472
LSUAC	St. Gabriel and Iberia	-	-	390
Variety Release Program	1° and 2° Stations	-	14	797
Kleentek	Foundation stock	-	3	20
Kleentek	1° increase farms	22	4	449
Kleentek	2° increase farms	19	3	539
Local Quarantine	LSU AgCenter	-	9	38
Research	LSU AgCenter	-	7	200
Totals		317		7905

Table 2. RSD field and stalk infection frequencies in different crop cycle years for all varieties combined during 2001.

Crop year	Total number of fields	Average field infection (%)	Total number of stalks	Average stalk infection (%)
Plant cane	132	6.8	2628	0.8
First stubble	74	8.1	1471	1.0
Second stubble	30	3.3	595	0.2
Older stubble	26	3.8	501	0.4
Unknown	14	7.1	277	0.4
Total	276	6.6	5472	0.7

Table 3. Sugarcane yellow leaf virus testing summary for 2001.

Source	Location	No. of fields	No. of varieties	No. of stalks
Louisiana growers	Statewide	16	1	792
Kleentek	Foundation stock	-	8	51
Kleentek	1° increase farms	54	4	1729
Kleentek	2° increase farms	34	4	1281
Local Quarantine	LSU AgCenter	-	-	88
Research	LSU AgCenter	-	-	4668
Totals		95	8	8609

Table 4. Sugarcane mosaic natural infection levels in yield trials on farms (outfield tests).

Variety	Infection (%)	Rating[a]	Variety	Infection (%)	Rating[a]
CP 70-321	3.17	2	HoCP 96-509	0.02	2
LCP 85-384	0.01	2	HoCP 96-540	0.00	1
HoCP 85-845	0.11	2	L 97-128	0.00	1
HoCP 91-555	0.05	2	L 97-137	0.00	1
L 95-462	0.00	1	HoCP 97-606	4.60	2
Ho 95-988	0.01	2	HoCP 96-609	0.00	1

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

Table 5. Smut infection level and resistance ratings for experimental varieties determined from an inoculated test.

Variety	Infection (%)	Rating[x]	Variety	Infection (%)	Rating[x]
CP 65-357	43	8	HoCP98-778	7	3
CP 70-321	3	2	HoCP98-781	2	2
CP 73-351	30	6	L 99-213	1	2
CP 74-383	23	5	L 99-214	46	8
TucCP 77-42	2	2	L 99-215	10	4
CP 79-348	2	2	L 99-221	0	1
CP 81-335	7	3	L 99-225	15	4
L 95-462	7	3	L 99-226	10	4
L 97-128	5	3	L 99-227	16	4
L 97-137	4	2	L 99-229	6	3
HoCP97-606	0	1	L 99-230	4	2
HoCP97-609	12	4	L 99-231	2	2
L 98-207	4	3	L 99-233	10	4
L 98-209	3	2	L 99-234	8	3
HoCP98-718	44	8	L 99-236	0	1
HoCP98-734	0	1	L 99-238	12	4
HoCP98-741	23	5	L 99-240	10	4
HoCP98-771	10	4	L 99-243	72	9
HoCP98-776	3	2			

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