

Resistance of 43 Sugarcane Clones to Smut (*Ustilago scitaminea* Sydow)¹

Rodrigo Echávez-Badel and Jorge L. Rodríguez²

ABSTRACT

Forty-three sugarcane clones were tested in the greenhouse for resistance to smut, *Ustilago scitaminea* Sydow, between December 1983 and January 1985. We inoculated forty pieces of seed cane per clone (one bud/seedpiece) by submerging them for 20 minutes in an aqueous suspension of teliospores (5×10^7 /ml). Inoculated seedpieces were incubated overnight, then planted in 20-cm diameter metal pots. Incidence of stool and stalk infections were followed. Stool infection increased after ratooning. Nine clones were smut resistant and three were tolerant at planting and at the first ratoon crop. Three clones, PR 70-2085, PR 77-1040, and PR 78-3005, did not show disease symptoms or smut whips during the experiment.

INTRODUCTION

Sugarcane smut (*Ustilago scitaminea* Sydow) is one of the most important diseases of sugarcane in Puerto Rico. The disease was first observed in 1981 on the south coast of the island (6). Its recent rapid spread is now threatening other sugarcane areas. A major factor for the rapid dissemination of this disease has been the use of susceptible varieties. Variety PR 980, which has been found to be susceptible to smut in Guyana, Jamaica (1) and Zimbabwe (3), occupies more than 40% of the sugarcane acreage in Puerto Rico. More than 30% of the plants in the Aguirre plantations were found to be infected with smut.³ The continued use of smut susceptible varieties threatens the Puerto Rican sugar industry. The objective of this research was to screen sugarcane clones for reaction to sugarcane smut disease under greenhouse conditions.

MATERIALS AND METHODS

The research was conducted in a greenhouse at the Gurabo Substation between December 1983 and January 1985. A total of 43 sugarcane clones, including the susceptible check PR 69-2030, were used in this trial. Whips were collected from infected sugarcane fields near Aguirre. Forty pieces of seed cane per variety (one bud/seed piece) were immersed 20 minutes in a suspension of 5×10^6 teliospores per ml of water

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² Assistant Phytopathologist and Associate Geneticist, respectively, Agricultural Experiment Station, College of Agricultural Sciences, Mayagüez Campus, University of Puerto Rico. The authors thank Juan Gómez and Elizardo Ojeda, Gurabo Substation; and Santos Morales, Central Aguirre, Sugar Corporation of Puerto Rico, for their useful cooperation in this experiment.

³ S. Morales, personal communication.

containing a surfactant. Before inoculation, 40% of the spores from a sample of the spore suspension were found to germinate. Inoculated seed pieces were incubated in plastic bags overnight, then planted in 20-cm diameter metal pots. The intensity of infection was expressed in percentage of infected stalks. Clonal smut reactions (frequency of infection) were evaluated on the basis of percentage infected stools. Clones were rated for resistance by the Hawaiian scale (5) slightly modified for us, in which grade 1 is resistant, with infection measured by the appearance of 0-3 and 0-6 percentage infected stools in plant and ratoon crops respectively, 2-4 is tolerant, grade 5 is intermediate, and grades 6-9 are susceptible. We used 26 and 31% infections and higher as the cut off point for susceptibility smut reaction in plant and ratoon crops, respectively. The plant cane was rated 11, 17 and 36 weeks after inoculation. Data were also recorded at 6, 11 and 19 weeks in the first ratoon crop.

RESULTS AND DISCUSSION

Tables 1 and 2 summarize smut reactions of 42 clones and the check. The incidence of infected stools increased approximately 40% in the first ratoon compared to plant crop at 17 week-old cane (tables 1 and 2). Similar results were reported in Hawaii (2), Florida (4), and Rhodesia (7). On the other hand, the intensity of infection decreased from 25% in plant cane to 18% in ratoon cane. This may probably have been because of the premature cutting of the ratoon crop when inoculum potential was at a maximum.

Percentage of infected stools increased during the period from 17 to 36 weeks after artificial inoculation (table 1), showing an increase of primary infection during this period. Nine clones (PR 66-2281, PR 70-2056, PR 70-2085, PR 75-372, PR 76-2052, PR 76-2070, PR 77-369, PR 77-1040, and PR 78-3005) were resistant; and three clones (PR 67-1070, PR 76-2, and PR 76-3110) were tolerant to smut in plant cane and the first ratoon crop (tables 1 and 2). Among resistant clones, PR 70-2085, PR 77-1040 and PR 78-3005 did not develop smut whips after the first ratoon crop (table 2). It is important to note that, compared with PR 69-2030, two of the best yielding clones PR 66-2281 and PR 67-1070, showed resistance and tolerance to smut, respectively, in plant cane and ratoon crop (tables 1 and 2). On the other hand, PR 69-2110 was susceptible to smut in Aguirre³, and was rated as susceptible in plant cane, but resistant to smut in the first ratoon crop. Further observations are needed to confirm the performance of this clone in the field.

Twenty-seven clones, including the check, were rated 6 or higher (table 2). Thirty-six weeks after inoculation (primary infection—table 3) the frequencies of varieties in the resistant grades were grade 1 = 40%, and grades 3 and 4 = 2%. About 9%, and 47% were in the intermediate and

TABLE 1.—*Reaction of 43 sugarcane varieties (plant cane) to smut disease, using artificial inoculation*

Variety	Infected stalks ¹	Infected stools ¹		Smut grade ²
		At 17 weeks	At 36 weeks	
		%	%	
PR 66-2281	0.0	0.0	0.0	1
PR 67-1070	5.0	0.0	9.0	3
PR 69-2110	20.0	6.0	44.0	7
PR 70-1011	48.0	54.0	100.0	9
PR 70-1029	14.0	0.0	29.0	6
PR 70-2016	9.0	3.0	26.3	6
PR 70-2056	2.0	0.0	3.0	1
PR 70-2085	0.0	0.0	0.0	1
PR 71-353	0.0	0.0	0.0	1
PR 75-329	26.0	5.0	40.0	7
PR 75-372	0.0	0.0	0.0	1
PR 76-2	0.0	0.0	0.0	1
PR 76-5	86.0	82.0	100.0	9
PR 76-19	54.0	32.0	100.0	9
PR 76-37	10.0	0.0	23.0	4
PR 76-274	0.0	0.0	0.0	1
PR 76-1101	18.0	6.0	44.0	7
PR 76-2052	1.0	0.0	3.0	1
PR 76-2070	0.0	0.0	0.0	1
PR 76-3025	32.0	14.0	76.0	9
PR 76-3107	44.0	19.0	69.0	7
PR 76-3110	0.0	0.0	0.0	1
PR 76-3221	0.0	0.0	0.0	1
PR 76-3258	0.0	0.0	0.0	9
PR 76-3405	34.0	8.0	100.0	7
PR 77-369	14.0	10.0	23.0	1
PR 77-1040	0.0	0.0	0.0	1
PR 77-3007	14.0	0.0	25.0	1
PR 77-3010	100.0	100.0	100.0	9
PR 77-3011	9.0	0.0	16.0	5
PR 77-3045	12.0	8.0	28.0	1
PR 77-3070	0.0	0.0	0.0	5
PR 77-3113	69.0	65.0	100.0	9
PR 77-3128	100.0	100.0	100.0	9
PR 78-261	8.0	4.0	14.0	5
PR 78-401	2.0	0.0	3.0	1
PR 78-414	13.0	0.0	20.0	5
PR 78-3005	0.0	0.0	0.0	1
PR 78-3008	75.0	47.0	100.0	9
PR 78-3009	34.0	12.0	47.0	7
PR 78-3023	78.0	60.0	100.0	9
PR 1028	44.0	41.0	100.0	9
PR 69-2030 (ck)	83.0	73.0	100.0	9
\bar{x}	25.0	17.0	38.0	

¹ Three readings taken 11, 17 and 36 weeks after inoculation.

² Hawaiian Scale: Grades 1-4 = resistant and tolerant; 5 = intermediate; 6-9 = susceptible.

TABLE 2.—*Reaction of 43 sugarcane varieties (first ratoon crop) to smut disease*

Variety	Infected stalks ¹	Infected stools ¹	Smut Grade ²
	%	%	
PR 66-2281	1.0	3.0	1
PR 67-1070	3.0	9.0	2
PR 69-2110	5.0	16.0	3
PR 70-1011	6.0	19.0	4
PR 70-1029	26.0	97.0	9
PR 70-2016	26.0	83.0	9
PR 70-2056	1.0	3.0	1
PR 70-2085	0.0	0.0	1
PR 71-353	18.0	97.0	9
PR 75-329	15.0	66.0	8
PR 75-372	3.0	6.0	1
PR 76-2	4.0	18.0	4
PR 76-5	58.0	100.0	9
PR 76-19	29.0	100.0	9
PR 76-37	15.0	48.0	7
PR 76-274	19.0	100.0	9
PR 76-1101	20.0	91.0	9
PR 76-2052	1.0	3.0	1
PR 76-2070	2.0	5.0	1
PR 76-3025	29.0	100.0	9
PR 76-3107	43.0	97.0	9
PR 76-3110	7.0	17.0	4
PR 76-3221	9.0	32.0	6
PR 76-3258	16.0	86.0	9
PR 76-3405	38.0	100.0	9
PR 77-369	1.0	3.0	1
PR 77-1040	0.0	0.0	1
PR 77-3007	30.0	100.0	9
PR 77-3010	57.0	100.0	9
PR 77-3011	23.0	61.0	8
PR 77-3045	11.0	53.0	7
PR 77-3070	5.0	25.0	5
PR 77-3113	15.0	35.0	6
PR 77-3128	30.0	75.0	8
PR 78-261	20.0	86.0	9
PR 78-401	26.0	88.0	9
PR 78-414	9.0	26.0	5
PR 78-3005	0.0	0.0	1
PR 78-3008	14.0	42.0	7
PR 78-3009	31.0	62.0	8
PR 78-3023	29.0	76.0	8
PR 1028	15.0	52.0	7
PR 69-2030 (ck)	67.0	94.0	9
\bar{x}	18.0	53.0	

¹ Three readings taken 6, 11 and 19 weeks after cutting.² Hawaiian scale: Grades: 1-4 resistant and tolerant; 5 = intermediate; 6-9 = susceptible.

susceptible grades, respectively. On the other hand, in secondary infection (table 3), the frequencies of varieties in different grades were grade 1 = 21%; grades 2 and 3 = 2%; grade 4 = 7%; intermediate and susceptible grades = 5% and 63%, respectively. There was no difference between frequencies in intermediate grades; however, the frequencies for susceptible grades were highest when the plant was ratooned, 63% vs. 47% (table 3).

Because clonal resistance is the most economical means of controlling sugarcane smut, the breeding program should continue developing smut resistant and tolerant varieties with resistant sources available from sugarcane germplasm. Resistant or tolerant clones screened in this test

TABLE 3.—Frequency of 43 sugarcane varieties in primary (plant cane) and secondary (ratoon crop) infections

Reaction	Plant cane		Ratoon crop	
	Smut grade ¹	Frequency (%) ²	Smut grade ¹	Frequency (%) ²
Resistant	1	40	1	21
Tolerant	2	0	2	2
Tolerant	3	2	3	2
Tolerant	4	2	4	7
Intermediate	5	9	5	5
Susceptible	6	5	6	5
Susceptible	7	14	7	9
Susceptible	8	0	8	12
Susceptible	9	28	9	37
Total susceptible		47		63

¹ Hawaiian scale.

² Frequency of varieties (%) = $\frac{\text{Frequency of grades in tables 1 and 2}}{\text{Number of varieties tested}} \times 100$.

will be included in a field smut test with inoculated susceptible checks in order to increase the inoculum in the field plots.

RESUMEN

Desde diciembre de 1983 a enero de 1985 se probaron en invernadero 43 clones de caña de azúcar para resistencia al carbón, *Ustilago scitaminea* Sydow. Se inocularon 40 trozos de caña (semilla) por variedad (una yema/semilla) sumergiéndolas por 20 min. en una suspensión acuosa de teliosporas (5×10^6 /ml). La semilla inoculada se incubó durante la noche, después se sembró en cubos de metal de 20 cm. de diámetro. Se observó periódicamente la incidencia de la infección en cepas y tallos durante el desarrollo de la epifitotia. La infección en las cepas aumentó cuando la

plantilla se dejó retoñar. Nueve clones mostraron resistencia al carbón y tres fueron tolerantes en la siembra de plantilla y en el retoño. Tres clones, PR 70-2085, PR 77-1040 y PR 78-3005, no mostraron los síntomas del carbón o brotes en forma de látigo en el transcurso del experimento.

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