

# Resistance to rust and smut among Puerto Rico sugarcane clones

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## ABSTRACT

One hundred and ninety-two sugarcane clones were evaluated for resistance to rust (*Puccinia melanocephala* H. Syd. & P. Syd.) and to smut (*Ustilago scitaminea* Syd.), between March 1985 and March 1988. Fifty-nine clones (31%) were resistant to both rust and smut in plant cane, and in the first and second ratoon crops. Incidence of smut increased after ratooning. Some 81 to 96% were resistant to rust. Rust resistance remained unchanged in plant cane and ratoon crops.

## RESUMEN

Evaluación de clones de caña de azúcar para la resistencia a la roya y al carbón

Desde marzo de 1985 a marzo de 1988 se evaluaron 192 clones para resistencia a la roya (*Puccinia melanocephala* H. Syd. & P. Syd.) y al carbón (*Ustilago scitaminea* Syd.). Cincuenta y nueve clones (31%) fueron resistentes a la roya y al carbón en la siembra de plantilla y en el primero y segundo retoños. Del total de clones probados 81 a 96% fueron resistentes a la roya. Esta resistencia permaneció inalterada durante la siembra de plantilla y de los retoños. La incidencia del carbón aumentó cuando la plantilla se dejó retoñar.

## INTRODUCTION

Smut (*Ustilago scitaminea* Syd.) and rust (*Puccinia melanocephala* H. Syd. & P. Syd.) are the most important diseases of sugarcane in Puerto Rico. A major factor for the rapid dissemination of both diseases has been the use of susceptible varieties. Both diseases have been reported recently in Puerto Rico (9,12). Natural infection tests, performed by exposing varieties to high levels of rust inoculum, have been conducted on the island (3,10). However, varietal reactions to smut have not been evaluated under conditions of natural infection in the field. Under greenhouse conditions employing artificial inoculation, nine clones have been found to be resistant (5). Alternatively, it has been shown that some sugarcane varieties have high levels of resistance to rust under field conditions (3).

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The existence of physiologic races of rust and smut has been reported worldwide (1, 10, 6, 7). Because of the rapid dissemination of both diseases in Puerto Rico, a series of promising, high-yielding hybrid sugarcanes from the AES-UPR cane breeding program were selected and monitored closely for resistance under field conditions.

#### MATERIALS AND METHODS

Field tests were conducted at the AES-UPR Gurabo Substation from March 1985 to March 1988. One hundred ninety-two clones were planted in nonreplicated, 1.5 m × 4.5 m field plots. Two smut-susceptible reference varieties (PR 77-3128 and PR 69-2030) and one rust-susceptible variety (PR 67-3129) were planted among the test clones at regular intervals, i.e., one reference plot per two test plots. Seed cane of variety PR 77-3128 was inoculated with *U. scitaminea* by the aqueous stem-immersion technique (5). Planting, cultivation, fertilization, and weeding followed the general practice of this area.

Clones were monitored for smut and rust symptoms during the course of three crops: the plant cane, and the first and second ratoon crops. Parameters used for smut monitoring in Hawaii (8), and for rust in Florida (13), were modified slightly for the present evaluations. In both numerical scales, the values 0 or 1 denote highest resistance and 9 denotes highest susceptibility. All clones were rated numerically at tillering (4 to 5 months of age) and at pre-maturity stages of growth (8-10 months of age). Rust infection and its severity was observed basipetally from the top visible dewlap (TVD) leaf (2).

#### RESULTS AND DISCUSSION

For rust in plant cane, (table 1), 81% of the test clones were resistant (grades 0 to 3). This resistance persisted throughout the ratoon crops. The rust-reference clone, PR 67-3129, was infected and ranked susceptible, with a severity grade of 7 (table 3.) This infection confirms the prevalence of rust at the testing site. In special reference to PR 67-1355,

TABLE 1.—Reaction of 195 sugarcane varieties in plant cane and ratoon crops to infection by *Puccinia melanocephala* at Gurabo, Puerto Rico

Reaction	Rust grade <sup>1</sup>	Percentage		
		Plant cane	First ratoon	Second ratoon
Resistant	0-3	81	81	96
Intermediate	4-5	15	7	1
Susceptible	6-9	4	12	3

<sup>1</sup>Control checks included.

<sup>2</sup>Modified Florida scale.

TABLE 2.—Reaction of 195 sugarcane clones in plant cane and ratoon crops to infection by *Ustilago scitaminea* at Gurabo, Puerto Rico

Reaction	Smut grade <sup>2</sup>	Percentage <sup>1</sup>		
		Plant cane	First ratoon	Second ratoon
Resistant	1	92	65	51
Tolerant	2-4	0	9	6
Intermediate	5	1	9	8
Susceptible	6-9	7	17	35

<sup>1</sup>Control checks included.

<sup>2</sup>Modified Hawaiian scale.

having good commercial performance in the sugar planting areas of Puerto Rico, susceptibility to rust was evident in plant and first ratoon crops. However, this cane appears most susceptible in the tillering phase, but is resistant at the pre-maturity stage (table 3). There is evidence that cane rust resistance relates to plant age (10, 13).

In the case of smut, the percentage of test clones showing susceptibility was highest in ratoon plants (17-35% vs. 7%) (table 2). Similar results have been reported from Hawaii (4) and in Puerto Rico (5).

Among the 192 sugarcane clones tested for resistance to rust and smut, 59 showed high levels of resistance to both diseases. More specifically, some 31% of all clones were resistant throughout the three crop cycles. Variety PR 68-2002, released for commercial use in 1987, showed degrees of smut tolerance and susceptibility in ratoon plants (table 3). On the other hand, the newly-released varieties PR 68-3120, PR 69-2218, PR 69-2247, and PR 67-1070 revealed high levels of resistance to both rust and smut disease (table 3). Variety PR 67-1355 was resistant to smut. The smut-susceptible reference clones indicated high degrees of infection through the three crop cycles (table 3).

In comparing the rust and smut reactions of the tested clones with the susceptible checks, the incidence of both diseases was high and remained almost unchanged during the three-year interval (table 3). Moreover, levels of rust and smut susceptibility in control plants were high everywhere they were planted. This finding indicates that *P. melanocephala* and *U. scitaminea* were uniformly distributed in the field test.

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TABLE 3.—Reaction of 7 sugarcane released varieties and 3 control checks to smut (*Ustilago scitaminea*) and rust (*Puccinia melanocephala*) among 195 genotypes planted at Gurabo, Puerto Rico

Clon	Plant cane <sup>1</sup>				First ratoon <sup>1</sup>				Second ratoon <sup>1</sup>			
	Smut <sup>2</sup>		Rust <sup>3</sup>		Smut <sup>2</sup>		Rust <sup>3</sup>		Smut <sup>2</sup>		Rust <sup>3</sup>	
	Grade	Reaction	Grade	Reaction	Grade	Reaction	Grade	Reaction	Grade	Reaction	Grade	Reaction
PR 67-1070	1	R	0*,0**	R,R	1	R	0*,0**	R,R	1	R	0*,0**	R,R
PR 67-1355	1	R	6,6	S,S	1	R	7,0	S,R	1	R	0,0	R,R
PR 68-2002	1	R	0,0	R,R	4	T	0,6	R,S	6	S	0,0	R,R
PR 68-3120	1	R	0,0	R,R	1	R	0,0	R,R	1	R	0,0	R,R
PR 69-2218	1	R	0,0	R,R	1	R	0,0	R,R	1	R	0,0	R,R
PR 69-2247	1	R	0,0	R,R	1	R	0,0	R,R	1	R	0,0	R,R
PR 980	1	R	0,0	R,R	5	I	0,0	R,R	1	R	0,0	R,R
PR 77-3128 <sup>4</sup>	9	S	0,0	R,R	7	S	0,1	R,R	9	S	0,1	R,R
PR 69-2030 <sup>4</sup>	6	S	0,0	R,R	7	S	0,0	R,R	8	S	0,0	R,R
PR 67-3129 <sup>6</sup>	1	R	7,7	S,S	3	T	7,8	S,S	7	S	7,6	S,S

<sup>1</sup>Two readings taken at tillering\* and pre-maturity\*\* stages of growth.

<sup>2</sup>Modified Hawaiian scale: Grade 1 = Resistant (R), 2-4 = Tolerant (T); 5 = Intermediate (I); and 6, 9 = Susceptible.

<sup>3</sup>Modified Florida scale: Grade 0-4 = Resistant (R), 5 = Intermediate (I), and 6, 9 = Susceptible (S).

<sup>4</sup>Smut susceptible checks.

<sup>6</sup>Rust susceptible check.

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