

SMUT INCIDENCE IN VARIETY TRIALS

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Abstract

Data are presented for several sugarcane crops showing the increase in the incidence of smut in 68 varieties planted in 16 trials. A summary of ratings of varietal resistance to smut is given. Two methods for establishing the smut resistance of varieties are discussed. It was concluded that the classification of susceptibility should be based on whip population data. The necessity for finding a variety (or varieties) of equal agronomic potential to NCo 376 is emphasised.

Introduction

The number of smut whips which developed in 68 varieties planted in 16 variety trials on the Experiment Station and on Triangle Sugar Estate have been counted over a number of crops, and the results have been classified according to the rating key given in Table 1.

TABLE I

Rating key for incidence of smut whips in sugarcane variety trials

Whips per ha.	Rating	Definition
0	0	Immune
1 — 60	1	Very highly resistant
61 — 120	2	Highly resistant
121 — 240	3	Resistant
241 — 625	4	Intermediate-resistant
626 — 1 875	5	Intermediate-average
1 876 — 5 000	6	Intermediate-susceptible
5 001 — 15 000	7	Susceptible
15 001 — 30 000	8	Highly susceptible
30 000	9	Very highly susceptible

This table is the metric version of a similar table presented by James⁵, and is based on the system proposed by Hutchinson⁴ for standardizing disease resistance ratings.

The results are shown in Tables 2 and 3.

Released varieties

Of the four released varieties available to the industry, Co 462 did not develop any smut in any of the variety trials listed in Tables 2 and 3. However, smut whips have been observed in this variety in certain commercial fields and in other experiments. It is therefore apparently not immune to infection. CP 29-116 is shown to be an "intermediate-average" to "susceptible" variety which develops more than 2 000 whips per hectare in the sixth ratoon. Because of its high susceptibility to smut, NCo 310 may only be grown in restricted areas of the lowveld (Gosnell³). This variety is now rapidly losing its erstwhile popularity. Table 2 shows that by the eighth ratoon stage of one variety trial at Triangle, NCo 310 developed more than 36 000 whips per hectare. NCo 376 is still the best released variety; however, it is smut susceptible (Tables 2 and 3).

Pre-release varieties

Co 1001, M 31-45 and N 52-219 are pre-release varieties. This means that both companies and growers can plant each variety up to 10% of their total area under cane (Gosnell²). Tables 2 and 3 show that Co 1001 has a high resistance to smut infection. M 31-45 did not develop the disease in any of the crops in the six variety trials reported in Tables 2 and 3. However, a few smut whips have been observed in this variety in the field. Twelve crops from four variety trials show that N 52-219 is also very highly resistant to smut (Table 3).

Varieties of promise

The following are varieties with possible future potential in the industry. This potentiality is based on their recoverable sugar yield expressed as a percentage of NCo 376 (Gosnell³).

CP 48-103 produced nearly 1500 whips per hectare in the second ratoon crop (Table 3). This is twice the whip population recorded in first ratoon. James⁷ has rated this variety as susceptible (rating 7) in smut exposure trials, and, as its sucrose yields have declined rapidly by the second ratoon stage (Gosnell³), its potential in the lowveld would appear to be waning.

Seven crops from two trials show that Q 63 has a useful resistance to smut (Table 3), and the rating from smut exposure trials makes this variety acceptable for commercial planting (James⁷). Table 3 shows that Q 70 is also resistant (rating 5), and its susceptibility to smut, as assessed in exposure trials, is relatively low.

Though the sucrose yields of N 55-805 and NCo 79 are relatively high in comparison with NCo 376, both are highly susceptible to smut (Table 2 and 3), and therefore are eliminated as varieties of promise in the lowveld.

The following four varieties, which compare favourably with NCo 376, have been harvested only once: B57150, Co 740, L 62-68, and Mex 59-1825. Though only a low incidence of smut was recorded in all four varieties in the plant crop, by the first ratoon stage comparatively high populations of smut whips had developed (Table 3). Smut exposure trials have shown Mex 59-1825 to be susceptible and L 62-68 to be highly susceptible (James⁷).

NCo 310 and INYATI, and other smut susceptible varieties

Table 3 shows that INYATI, formerly thought to be a smut-resistant mutant of NCo 310 from observations made at Chirundu, is as susceptible as NCo 310.

In variety trial 3 (Table 2) at Triangle Sugar Estate, Co 911 and CoS 443, which in the plant crop had a low incidence of smut (148 and 173 whips per hectare respectively), showed themselves to be highly susceptible by the third ratoon stage

TABLE II
Smut resistance ratings in five variety trials at Triangle Sugar Estate

Variety	Experiment Number	Crop								
		P	1R	2R	3R	4R	5R	6R	7R	8R
B 37172	3	2	4	6	6					
B 42231	4	0	4	4	5					
	5	0	4	4	4					
B 4362	3	3	2	5	6					
CB 36—14	2	—	—	4	—	5	5			
CB 38—22	2	—	—	4	—	5	5			
CB 40—77	4	0	2	0	0					
Co 421	1	—	—	6	—	6	6	6	6	7
Co 426	2	—	—	0	—	0	0			
Co 617	3	2	4	5	6					
Co 678	5	0	4	5	4					
Co 775	3	0	1	1	4					
Co 911	3	3	5	8	8					
Co 976	4	0	3	4	4					
Co 1001	4	0	0	2	0					
	5	0	0	0	1					
CoS 443	3	3	5	8	9					
CP 29-116	1	—	—	5	—	5	5	6	5	5
CP 43-47	4	0	4	4	2					
	5	0	5	4	5					
M 383-41	4	0	0	0	0					
M 31-45	4	0	0	0	0					
	5	0	0	0	0					
N 50-211	2	—	—	5	—	6	5			
N 51-168	5	0	3	5	4					
N 51-539	5	0	4	4	4					
N 53-216	4	0	4	5	6					
NCo 79	2	—	—	6	—	7	8			
NCo 293	1	—	—	7	—	9	9	9	9	9
NCo 310	1	—	—	7	—	8	8	9	9	9
	2	—	—	8	—	8	7			
	3	4	5	7	7					
NCo 334	1	—	—	5	—	7	7	7	8	8
NCo 339	3	0	4	5	6					
NCo 376	1	—	—	6	—	7	7	7	7	7
	3	1	3	5	6					
	4	2	5	5	5					
	5	0	6	6	5					
Pindar	4	3	5	5	4					
PR 1000	3	0	2	4	4					
Q 58	4	0	2	2	1					
Q 70	4	0	2	3	2					
	5	0	3	4	3					

TABLE III
Smut resistance ratings in eleven variety trials at R.S.A. Experiment Station

Variety	Experiment Number	Crop					Variety	Experiment Number	Crop				
		P	1R	2R	3R	4R			P	1R	2R	3R	4R
B 3439	1	0	0	1	2	1	L 62-68	9	0	6			
	5	—	—	1	2			L 62-96	9	4	6		
B 42231	1	1	0	1	3	4	M 383-41	1	0	0	3	0	0
	2	—	4	4	4	5		2	—	0	0	0	0
	5	—	—	4	5			3	0	1	0	0	
B 4362	11	—	1	1	1			4	0	0	0	0	
B 47419	8	1	1					5	—	—	0	0	
B 57150	8	1	5					7	0	0	0		
CB 36-14	11	—	4	4	4			M31-45	1	0	0	0	0
CB 38-22	1	0	0	1	1	2	2	—	0	0	0	0	
CB 40-77	1	0	0	0	0	0	5	—	—	0	0		
CB 40-77	4	0	1	0	1		7	0	0	0			
	5	—	—	0	2		M 202-46	1	0	0	0	0	0
	7	3	0	0			5	—	—	5	1		
Co 462	7	0	0	0			Mex 54-81	9	1	7			
	11	—	0	0	0		Mex 55-261	9	5	5			
Co 678	2	—	0	0	2	3	Mex 56-476	9	7	9			
	3	0	0	2	1		Mex 57-337	9	0	0			
	6	1	2	3			Mex 59-1828	9	1	6			
Co 684	3	1	1	4	4		Mex 60-1403	9	0	1			
Co 740	8	1	6				N 51-168	2	—	1	4	3	4
Co 746	6	1	7	8			N 51-539	2	—	3	4	4	5
Co 775	2	—	0	0	0	0	N 52-219	3	1	1	0	0	
	3	1	3	1	0		6	0	0	0			
	5	—	—	2	0		7	0	0	0			
Co 957	2	—	0	1	0	2	8	0	0				
Co 976	1	0	3	4	3	3	N 53-216	1	0	0	5	6	6
	5	—	—	4	4		4	0	5	7	7		
Co 1001	1	0	0	1	0	0	5	—	—	5	6		
	2	—	1	0	0	0	N 55-805	7	4	6	8		
	4	0	0	0	0		8	0	8				
	5	—	—	0	0		NCo 310	8	4	9			
	7	1	0	0			Inyati	6	2	8	8		
	8	0	0				8	2	9				
CoS 109	2	—	2	1	0	0	10	—	6	7	7		
CP 29-116	10	—	2	3	5		11	—	5	7	7		
	11	—	1	3	4		NCo 376	1	1	3	4	5	6
CP 36-105	6	1	6	5			2	—	1	5	5	6	
CP 43-47	1	0	0	1	3	4	3	1	5	5	5		
	2	—	0	1	3	3	4	0	5	5	6		
	5	—	—	4	3		5	—	—	5	5		
CP 48-103	6	3	5	5			6	0	7	8			
Ebene 1-37	2	—	1	0	0	0	7	1	5	8			
L 60-25	9	0	1				8	1	8				
L 61-43	9	3	7				9	4	7				
L 61-67	9	1	5				10	—	4	5	6		
							11	—	4	5	6		
							Pindar	1	1	2	4	4	5
							4	1	5	5	5		
							5	—	—	4	3		
							6	0	5	5			

TABLE III (Continued)

Variety	Experiment Number	Crop				
		P	1R	2R	3R	4R
	7	2	2	4		
	8	1	6			
PR 980	8	4	5			
PR 999	8	4	5			
Q 57	2	—	6	7	7	7
	3	6	7	9	9	
Q 58	1	0	0	0	0	1
	4	0	0	0	3	
	5	—	—	0	0	
Q 61	6	4	1	3		
Q 63	3	1	1	2	3	
	6	1	4	4		
Q 67	6	3	6	5		
	8	3	6			
Q 68	6	1	6	7		
Q 70	1	0	0	0	1	2
	2	—	0	0	0	2
	3	0	0	0	1	
	4	0	0	1	1	
	5	—	—	0	0	
Q 71	6	1	7	7		
Q 76	6	1	9	9		
	8	4	8			
Q 80	6	0	0	1		
Ragnar	8	0	4			

(Co 911 with more than 20 000 whips per hectare, and CoS 443 with more than 30 000 whips per hectare). Similarly, NCo 293 and NCo 334 were shown to be highly susceptible to smut (Table 2).

Q57, a variety which compared favourably with NCo 376 in recoverable sugar per hectare in the plant crop (Experiment No. 2, Table 3), declined very rapidly in sucrose yield in subsequent ratoons (Gosnell³), with a concurrent increase in the incidence of smut. Not only is this variety highly smut susceptible, but it is also highly sensitive to infection. Because Q57 produced a very high smut whip population in the plant crop of a smut exposure trial, a weakening of the stools resulted, so much so that it began to die out due to lack of food reserves necessary for the first ratoon crop.

Table 3 shows the high degree of smut susceptibility of Q76, where in Experiment No. 6 whip populations increased from 18 per hectare in the plant crop to more than 46 000 per hectare in the second ratoon crop. Mex 56-476 is also shown to be a variety which is highly susceptible to smut. There were nearly 10 000 whips per hectare in the plant crop, and by the first ratoon stage the population of smut whips had increased to over 30 000 per hectare (Table 3).

Table 4 is a summary of resistance ratings for the 68 varieties discussed above. The numbers in brackets are smut susceptibility ratings calculated from five smut exposure trials (James⁷).

TABLE IV
Smut resistance ratings of 68 sugarcane varieties

Variety	Rating	Variety	Rating	Variety	Rating
B 3439	2 (3)	CP 29-116	5	N53-216	7 (7)
B 37172	6 (6)	CP 36-105	6 (4)	N55-805	8 (9)
B 42231	5 (8)	CP 43-47	4 (7)	NCo 79	8
B 4362	6 (6)	CP 48-103	5 (7)	NCo 293	9
B 47419	1	Ebene 1-37	1 (6)	NCo 310	9
B 57150	5	L 60-25	1 (5)	NCo 334	8
CB 36-14	7 (7)	L 61-43	7 (9)	NCo 339	6
CB 38-22	5 (6)	L 61-67	5 (7)	NCo 376	7 (9)
CB 40-77	2 (7)	L 62-68	6 (8)	Pindar	5 (6)
Co 421	6	L 62-96	6 (8)	Pr 980	5
Co 462	1* (0)	M 383-41	2 (6)	Pr 999	5 (5)
Co 617	6	M 31-45	1* (0)	Pr 1000	4
Co 678	4 (5)	M 202-46	4 (4)	Q 57	9 (9)
Co 684	4 (4)	Mex 54-81	7 (9)	Q 58	2 (6)
Co 740	6	Mex 55-261	5 (6)	Q 61	3 (4)
Co 746	5	Mex 56-476	9 (9)	Q 63	4 (6)
Co 775	3 (5)	Mex 57-337	1 (6)	Q 68	7 (9)
Co 911	8	Mex 59-1828	6 (6)	Q 70	2 (5)
Co 957	2 (6)	Mex 60-1403	1 (5)	Q 71	7 (9)
Co 976	4 (7)	N 50-211	6	Q 76	9 (9)
Co 1001	1 (0)	N 51-168	4 (8)	Q 80	1 (0)
CoS 109	2 (4)	N 51-539	5 (8)	Ragnar	4
CoS 443	9	N 52-219	1 (0)		

* Assessment adjusted on field experience.

Discussion and Conclusions

Early¹, assessing the susceptibility of varieties to smut on the basis of the number of infected stools which develop in a crop exposed to natural infection, gives both NCo 310 and NCo 376 much higher resistance ratings than those shown in Table 4. However, his assessments were made on a first ratoon crop of NCo 310 and a plant crop of NCo 376. Tables 2 and 3 show that smut incidence can increase dramatically in successive ratoons. Therefore, categorisation of varietal resistances to smut from plant crops or early ratoons alone can be misleading. Basing the assessment of smut resistance on percentage stools infected in any crop can also lead to anomalies. By Early's system, CP 29-116 was given the rating 9 (very highly susceptible) in the plant crop, but by first ratoon this same variety was rated 3 (resistant). James⁶ has given strong evidence to support the theory that smut infection can become latent, and Early's data for CP 29-116 would appear to be further corroboratory evidence. It is therefore submitted that, as the smut whip is the symptom of infection, estimation of smut whip population per hectare is a more dependable guide to a variety's susceptibility.

The smut susceptibility ratings of CP 29—116, NCo 310 and NCo 376 have been changed since 1969, and all three varieties are now assessed to be more susceptible (James⁵), whilst Co 462 is still rated as very highly resistant. As NCo 376 accounts for approximately 75% of the present

crop, and it is known that this variety can develop a high incidence of disease under heavy inoculum pressure, the continued cultivation of highly infected fields of NCo 310 could severely depress production. Smut infection has been shown to decrease yields by two tons sucrose per hectare in NCo 376 (James⁸). It is therefore hoped that a variety (or varieties) will emerge from variety trials, which will not only be smut resistant, but also be agronomically better than, or at least equal to, NCo 376.

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