SEEDLING SELECTION AND RESISTANCE TO SMUT DISEASE IN SUGARCANE

By K. J. NUSS

South African Sugar Association Experiment Station, Mount Edgecombe

Abstract

Resistance to smut disease is an important selection criterion in the breeding programme at the northern field station where the commercial clones are susceptible. The smut incidence in five consecutive series of the second selection stage revealed parental clones giving a high proportion of smut resistant clones.

Introduction

Smut disease of sugarcane, caused by the fungus *Ustilago scitaminea* was first recorded in South Africa in the clone 'China cane' in 1877[1]. Although smut disease had caused the destruction of this clone in certain districts by 1882, it eventually disappeared, and was not seen again until 1944/45; it was then found in Co 301 (McMartin[5]). Because of the extreme susceptibility of Co 301, this clone was removed from the list of released clones in 1964 (Thomson[7]). At the present time, smut is seldom found in the main sugar belt but in the northern, irrigated areas it has become a very serious problem. Most of the commercial clones, except the newly-released N52/219, show at least some degree of susceptibility. NCo 376 was formerly regarded as resistant, but the incidence of smut is now increasing in this important clone. For this reason smut resistance is an important factor in the selection programme at our northern field station, at Pongola.

This paper deals with the incidence of smut disease at the second selection stage in the breeding programme at Pongola for the 69 to 73 series.

Methods

The plant breeding programme consists of five selection stages. The first is the single stool stage, from which an average of 8 per cent of the clones are taken to the single line stage. In the latter, selected clones are planted in unreplicated lines of 8 metres. Clones in the single line stage are weighed and sampled for sucrose at the time of harvesting; selections to the next stage are made in first ratoon. The main selection criteria used are mass sucrose and disease resistance. Two disease inspections are carried out in the plant cane and three in the ratoon. The series number refers to the last two figures of the year the clones were planted in the single line stage.

In the work referred to here, two clones, NCo 310 and NCo 376, were planted as alternate controls among the single lines. Reactions of these controls to smut disease were also recorded. Diseased stools resulted from natural infection and not from artificial inoculation.

Results

The size of the programme expanded from the 69 series to the 73 series, with the number of parent clones, crosses, single lines and control lines all showing marked increases (Table 1).

In all, 161 clones were used in 330 crosses. More than 90% of these crosses were biparental; none was repeated. The incidence of smut in the single lines and in NCo 310 increased rapidly up to and including the 72 series and decreased again in the 73 series. The average infection rate of NCo 310 lines was 26,0% whereas for NCo 376 lines it was only 2,1%. The incidence in NCo 376 lines was consistently low.

Parent clones producing a total of more than 100 single lines for 3 or more different crosses are entered in Table 2.

The smut resistance rating of the parent clones (when known) is also included. The variation in smut incidence from year to year was disregarded in compiling Table 2. The series numbers for the single lines were entered for reference purposes.

Fifteen of the 45 varieties gave progeny of which less than 10% were found with smut. One variety, CB 40/69 benefited from being included in the 69 and 70 series only, that is to say being tested at a time when smut incidence was low. Nevertheless, the progeny of CB 40/69 in the later stages of selection showed good resistance to smut. Although N52/219 is highly resistant to smut, its progeny are more susceptible than those of many other clones. The difference in resistance to smut between NCo 310 and NCo 376 was also shown by their progenies in their reaction to smut.

TABLE 1

Numbers of clones, crosses, single lines and controls in series 69 to 73

Series	No. of clones in crosses	No. of crosses	Single Lines			NCo 310 Lines			NCo 376 Lines		
			No.	No. with smut	% with smut	No.	No. with smut	% with smut	No.	No. with smut	% with smut
69	12	13	1 289	88	6,8	65	0	0	64	1	1,6
70	42	60	2 770	253	9,1	122	11	9,0	125	4	2,4
71	64	70	2 071	291	14,1	102	35	34,3	101	3	3,2
72	60	74	2 692	819	30,4	140	76	54,3	138	4	2,9
73	92	113	3 367	468	13,9	160	31	19,4	190	1	0,5
Total	161	330	12 189	1 919	Mean 15,7	589	153	Mean 26,0	618	13	Mean 2,1

TABLE 2
Reaction to smut of parent clones and their progeny in single lines

Parent clone	Smut resistance rating		No. of crosses	No. of single lines	No. of single lines with smut	% single lines with smut	Series
	Pongola*	Rhodesia†					
CB 38/22	2	6	7	217	18	8,3	70-73
CB 38/39			10	761	78	10,3	69, 70, 72
CB 40/35			11	751	32	4,3	69, 70, 72
CB 40/69			7	658	15	2,3	69,70
Co 301	8		6	251	86	34,3	70, 72, 73
Co 419			13	487	56	11,5	70, 71, 73
Co 421		6	18	741	111	15,0	69, 70, 72, 73
Co 1001	2	1	5	124	7	5,6	73
CP 36/211	2		4	107	16	14,9	70, 72
CP 43/64	5		6	167	13	7,8	71
CP 44/101	8		9	547	79	14,4	69, 70, 72, 73
CP 44/154			6	270	42	15,6	71-73
CP 48/103	5	5	3	113	21	18,6	72, 73
CP 52/68		5	4	238	15	6,3	70-73
F 151	2	4	5	123	7	5,7	73
H38-4443	2		4	192	39	20,3	72
H41-3340	8		4	101	48	47,5	72, 73
M383/41	2	4	3	100	6	6,0	71, 72
N6	8		12	495	102	20,6	70, 72, 73
N7	8		16	463	129	27,9	71-73
N10	8		6	308	64	20,8	71, 72
N51/168	2	6	11	652	58	8,9	69-71
N52/214			6	314	33	10,5	69, 70, 72
N52/219	2	1	10	543	64	11,8	70-73
N52/451			9	412	23	5,6	70-73
N55/805	8	9	9	439	88	20,0	69-73
N59/1312	2		4	107	7	6,5	71, 73
N61/1081			3	141	15	10,6	71-73
NCo 293	8	9	19	784	147	18,8	69-73
NCo 310	8	9	40	1 206	284	23,5	70-73
NCo 334	2	7	5	169	11	6,5	71, 73
NCo 339	2	6	5	141	27	19,2	72, 73
NCo 349			5	173	38	22,0	70-72
NCo 376	2	8	32	1 317	179	13,6	69-73
NCo 382	5		5	170	14	8,2	70-72
NCo 390	8		7	141	52	36,9	70-72
NM 37			4	151	16	10,6	70-72
NM 222			11	544	69	12,7	71-73
POJ 2725			4	102	3	2,9	70, 72, 73
Q49	2		3	234	32	13,7	69, 72
Q65	2		5	248	21	8,5	70, 72, 73
Q79	5		4	115	36	31,3	73
R366			3	104	14	13,5	71
47R2777	5		3	123	38	30,9	71, 72
US1694			3	152	29	19,1	70-72

* Smut rating in yield trials. 2 = resistant, 5 = intermediate, 8 = susceptible. † International rating 1-9. James (2), (3).

Discussion and conclusions

The reaction of single lines to smut cannot be determined from the parental resistance ratings. For example, a cross between the smut susceptible NCo 293 and CP 44/154, the progeny of which had a 15,4% incidence of smut in single lines, resulted in 52 single lines and of these only two were found with smut. Crosses with a resistant clone such as N52/219 do not necessarily give a high proportion of resistant progeny. This confirms recent findings in Hawaii.[4]

The progeny of several clones had a low number of smut infected single lines. Two such clones were CP 43/64, whose progeny is susceptible to leaf scald, and N52/451, which is susceptible to mosaic. Both clones will have to be crossed with ones imparting the necessary resistance in order to avoid their progeny having susceptibility to the above-mentioned diseases. There are other promising clones, however, such as CB 40/35, CB 40/69, Co 419, N52/214 and Q65 which do not have the disease susceptibility of CP 43/64 and N52/451. Two of these clones, CB 40/35 and N52/214 have previously been reported as being good parents.[6]

In conclusion it may be said that smut incidence in the single lines at Pongola has shown that the progeny of smut-resistant clones still have themselves to be screened for smut resistance because even resistant clones may give susceptible offspring. However, several clones have been found to give a high percentage of resistant offspring, and some of these clones are known to be good parents in other respects.

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