

# PARENTAL PERFORMANCE OF CERTAIN SUGARCANE VARIETIES

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## ABSTRACT

A survey of secondaries—that is, seedlings reaching the final variety testing stage—was undertaken for the years 1968 to 1973. Of the 223 varieties in the crossing programme, 34 varieties produced all of the 109 secondaries. Co 331, the most frequently used variety, produced 34 secondaries. However, the number of seedlings planted per secondary obtained was lower for NCo 376 and NCo 310 than for Co 421, Co 312, Co 301 and Co 331. Of the 53 parental crosses giving secondaries, 20 were responsible for three-quarters of the total number of secondaries. A certain amount of inbreeding was apparent in the derivation of the secondaries. The varieties Co 213, Co 285 and either POJ 2878 or POJ 2725 played a large part in the derivation of all the secondaries.

## Introduction

The improvement of sugarcane yields due to hybrid varieties is well-known. In South Africa the NCo varieties have contributed largely to the amount of sugarcane produced.<sup>1</sup> These varieties have also been used in the breeding programme, together with lesser known varieties, in an effort to obtain improved varieties.

To take stock of the breeding programme, a survey was conducted on the seedling varieties which, between 1968 and 1973, reached the final testing stage before a variety is considered for release. Such varieties are referred to here as "secondaries". "NCo varieties" is used as a collective term for varieties numbered from 291 to 378, and originating from the cross Co 421 x Co 312. (NCo 79 and NCo 382 are of different parentages, and are not included here under the general term of "NCo varieties"). In lists of crosses, the female parent is not necessarily given first.

## Collated information

### *Varieties in the breeding programme*

The secondary varieties originated from crosses made between 1955 and 1964. The number of seedlings sown per year ranged from 38 000 to 104 000, and totalled 489 500. The total number of secondaries obtained was 109. Two hundred and twenty-three varieties were used in the crossing programme, but 61 of these gave less than 10 seedlings each.

Varieties which gave rise to secondaries are entered in Table 1. Co 331 was the most frequently used parent, followed by Co 301, NCo 293 and Co 421. The numbers of seedlings obtained from different varieties ranged from 130 for N 55/176 to 111 063 for Co 331.

Most secondaries were obtained from Co 331, but many also came from NCo 376, Co 285 and NCo 310. However, the number of seedlings planted per secondary obtained was considerably less for NCo 376 and NCo 310 crosses than for Co 421, Co 312, NCo 339, Co 301 and Co 331 crosses. Several varieties which had not been used a great deal, but which nevertheless produced two or more secondaries, had lower seedling numbers per secondary than NCo 376.

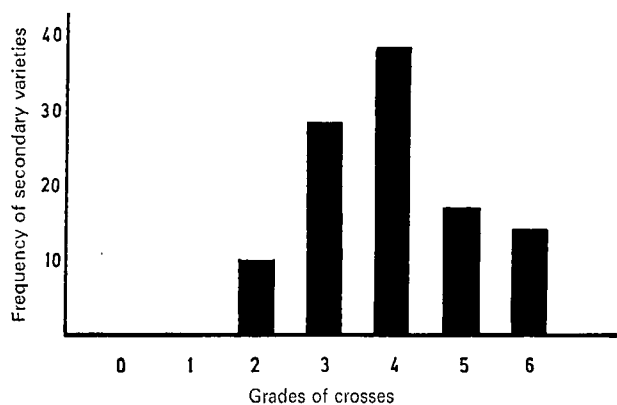
TABLE I

Numbers of crosses, seedlings and secondaries from certain varieties

Varieties	Total no. of crosses 1955-64	Crosses giving secondaries		No. of secondaries	No. of seedlings per secondary
		No. of crosses	No. of seedlings		
CB 38/39	6	1	380	1	380
CB 40/35	3	2	2 967	5	593
Co 205	10	1	3 775	1	3 775
Co 285	51	11	61 042	22	2 775
Co 301	64	9	64 027	17	3 766
Co 312	23	2	44 968	9	4 996
Co 331	97	13	111 063	34	3 266
Co 419	14	1	1 750	2	875
Co 421	59	5	79 125	15	5 275
Co 453	11	1	1 481	2	740
CoL 9	1	1	830	1	830
CP 36/85	10	1	839	1	839
CP 36/211	4	1	218	1	218
CP 44/101	3	1	833	1	833
CP 51/27	1	1	216	1	216
Melting Pot	49	5	4 050	8	506
33 MQ 157	2	1	187	1	187
N 7	5	2	1 730	2	865
N 8	3	1	2 487	1	2 487
N 10	12	1	534	1	534
N 51/539	7	2	792	2	396
N 52/214	5	3	4 234	5	847
N 54/533	3	1	589	1	589
N 55/176	6	1	130	1	130
N 57/1917	4	1	379	1	379
NCo 79	7	1	1 647	1	1 647
NCo 291	9	1	470	1	470
NCo 292	16	3	13 870	6	2 312
NCo 293	63	11	37 472	17	2 204
NCo 310	27	4	43 750	20	2 187
NCo 339	27	4	32 236	7	4 605
NCo 376	49	7	42 333	23	1 840
NCo 382	37	4	6 931	5	1 386
NM 222	12	1	833	1	833
POJ 2878	10	1	3 232	1	3 232

### *Parental combinations*

Visual grades are assigned to seedlings of crosses in the first stage of selection. These grades range from 0 to 6, indicating crosses rated from very poor to very good. Frequencies of grades of crosses giving secondaries are shown in Fig. 1. No secondaries were obtained



**FIGURE 1** Frequencies of secondary varieties and grades of parental crosses.

from the poorer-looking crosses. However, this has happened in the years before those considered here.

Combinations of varieties which result in secondaries are entered in Table II. Eleven secondaries were obtained from the cross Co 331 x NCo 310, eight from the cross Co 312 x Co 421 and seven from Co 331 x NCo 376. The number of seedlings planted per secondary obtained varied from 47 (for N 51/539 x NCo 293) to 13 246 (for Co 331 x NCo 293) and 13 399 (for Co 285 x NCo 339). The latter crosses appeared promising in the early stages and were repeated often, but they yielded only one secondary each. Several crosses gave two or more secondaries each from fewer than 1 000 seedlings per secondary. This is in contrast to many crosses that were repeated often, such as those mentioned above, as well as Co 331 x NCo 310 and Co 312 x Co 421.

Crosses with Co varieties yielded 84 secondaries from an average of 3 719 seedlings. Crosses among varieties other than Co varieties gave 25 secondaries from 747 seedlings. Melting pot crosses that produced secondaries were even more efficient, producing eight secondaries from an average of 506 seedlings.

*Parentages of secondaries*

A study of parentages of secondaries revealed that many parent combinations involved a certain degree of inbreeding. Secondaries were even obtained from close breeding, as in the sib-mating NCo 292 x NCo 376. More examples where inbreeding has shown promise are many crosses of the NCo varieties with either Co 285, Co 301 or Co 331.

Parentages of secondaries were traced back to four generations. Seventy-seven secondaries had one or more of the NCo varieties in their parentage. Four varieties were common to the ancestry of most secondary varieties, viz. Co 213, Co 285, POJ 2878 and, to a lesser extent, POJ 2725. The frequency of each of these varieties, expressed in sixteenths, is referred to as the Common Parent Ratio (CPR). For NCo 310 it is:

$$\left. \begin{matrix} 4/16 \text{ Co 213} \\ 4/16 \text{ Co 285} \\ 4/16 \text{ POJ 2878} \end{matrix} \right\} \text{CPR} = (4:4:4:0)12$$

**TABLE II**  
Crosses that gave secondaries

Crosses producing secondaries	No. of secondaries	No. of seedlings planted	No. of seedlings per secondary
CB 38/39 x NCo 293	1	380	380
CB 40/35 x Co 285	1	1 282	1 282
x NCo 293	4	1 685	421
Co 205 x NCo 293	1	3 775	3 775
Co 285 x Co 301	2	3 939	1 970
x Co 312	1	1 722	1 722
x Co 331	1	5 278	5 278
x CoL 9	1	830	830
x NCo 291	1	470	470
x NCo 292	4	7 119	1 780
x NCo 293	1	2 863	2 863
x NCo 310	5	14 047	2 809
x NCo 339	1	13 399	13 399
x NCo 376	4	10 093	2 523
Co 301 x Co 331	1	11 699	11 699
x Co 421	1	3 343	3 343
x N 7	1	757	757
x NCo 292	1	6 298	2 298
x NCo 293	2	9 136	4 568
x NCo 310	1	7 113	7 113
x NCo 339	2	9 343	4 672
x NCo 376	6	12 399	2 067
Co 312 x Co 421	8	43 246	5 406
Co 331 x Co 421	4	30 974	7 743
x CP 36/211	1	218	218
x CP 51/27	1	216	216
x N 10	1	534	534
x N 52/214	2	1 845	922
x N 57/1917	1	379	379
x NCo 293	1	13 246	13 246
x NCo 310	11	22 114	2 010
x NCo 339	2	7 982	3 991
x NCo 376	7	13 761	1 966
x NCo 382	1	2 817	2 817
Co 419 x M.P.	2	1 750	875
Co 421 x N 7	1	973	973
x N 54/533	1	589	589
Co 453 x NCo 293	2	1 481	740
CP 36/85 x NCo 382	1	839	839
CP 44/101 x NM 222	1	833	833
33 MQ 157 x M.P.	1	187	187
N 51/539 x NCo 293	1	47	47
x M.P.	1	745	745
N 52/214 x NCo 293	2	1 497	748
x M.P.	1	892	892
NCo 79 x NCo 382	1	1 647	1 647
NCo 292 x NCo 376	1	453	453
NCo 293 x N 55/176	1	130	130
x POJ 2878	1	3 232	3 232
NCo 310 x M.P.	3	476	158
NCo 339 x NCo 376	2	1 512	756
NCo 376 x N 8	1	2 487	2 487
x NCo 382	2	1 628	814
Total	109	285 700	Mean = 2 621

Where a variety has POJ 2725 in its parentage, e.g. NCo 382, the CPR is:

$$\left. \begin{matrix} 4/16 \text{ Co 213} \\ 0/16 \text{ Co 285} \\ 0/16 \text{ POJ 2878} \\ 8/16 \text{ POJ 2725} \end{matrix} \right\} \text{CPR} = (4:0:0:8)12$$

Secondaries with similar CPR's were grouped and entered in Table III. The highest number of secondaries had a CPR = 10 (6:2:2:0), a ratio which results from

crosses between Co 331 or Co 301 and the NCo varieties. Thirty-three such secondaries were obtained from an average of 3 072 seedlings per secondary. CPR 12 (4:4:4:0) with 17 and CPR 14 (2:10:2:0) with 16 were also important in producing secondaries. The efficiency in terms of seedling numbers was, however, lower for these CPR groups when compared to others.

TABLE III  
Common parent ratios of secondaries

Common parents 1/16				Total	No. of secondaries	No. of seedlings planted	No. of seedlings per secondary
Co 213	Co 285	POJ 2878	POJ 2725				
1	9	5	—	15	2	1 562	781
2	2	10	—	14	1	3 232	3 232
2	10	2	—	14	16	47 991	3 000
2	12	—	—	14	1	830	830
3	7	3	—	13	1	2 487	2 487
4	4	4	—	12	17	79 575	4 681
4	8	—	—	12	4	10 939	2 735
5	5	1	—	11	1	757	757
5	3	3	—	11	1	130	130
4	3	4	—	11	2	1 497	748
6	2	2	—	10	33	101 392	3 072
2	6	2	—	10	2	1 481	740
2	2	6	—	10	1	380	380
7	1	1	—	9	1	534	534
6	1	2	—	9	3	2 224	741
8	—	—	—	8	1	11 699	11 699
4	2	2	4	12	2	1 628	814
6	—	—	4	10	1	2 817	2 817
2	—	—	8	10	2	2 486	1 243
4	—	—	4	8	1	218	218
4	—	—	2	6	1	216	216
* Melting pot crosses					8	4 050	506
† Other crosses					7	7 575	1 082
Total					109	285 700	Mean = 2 621

\* Maternal parents have varying frequencies of CPR.

† The crosses are:

CB 40/35 × Co 285 — CB 40/35 } unknown parentage  
 × NCo 293— CB 40/35 } unknown parentage  
 Co 205 × NCo 293— Co 205 } no CPR varieties  
 CP 44/101 × NM 222.— CP 44/101 } no CPR varieties

Other varieties have varying frequencies of CPR.

All the secondaries of which the pedigrees were known had Co 213 in their parentage. Several secondaries did not have Co 285 and POJ 2878 in their ancestry. When POJ 2878 was absent, its sister variety POJ 2725 was often present in the ancestry.

#### Discussion and conclusions

The extensive use of Co 331 in the breeding programme has resulted in its being a parent of more secondaries than any other variety. In the period covered by the survey, it was frequently used as a parent because:

- (i) it is a prolific pollen producer;
- (ii) it flowers readily and over a long period; and
- (iii) seedlings of Co 331 are vigorous and have a good appearance.

However, seedlings of Co 331 tend to have a low ERS content, and for this reason other varieties are now preferred as parents. Some varieties which are showing promise are CB 40/35, Co 453, N 7, N 51/539 and N 52/214.

The Co varieties 285, 301, 312, 331 and 421 were extensively used in the crossing programme. Although many secondaries were obtained from these varieties, the efficiency of seedling numbers per secondary obtained were considerably less than for crosses among certain other varieties. This indicates that less emphasis should be placed on these Co varieties as parents.

It is of interest to note that although close breeding was not specially chosen as a deliberate breeding policy at the Experiment Station,<sup>3</sup> many of the secondaries have been derived in this way, and few have resulted from wide crossing. The amount of inbreeding in the parentage of secondaries was unexpectedly high. In 35 combinations producing 74 secondaries, there was a varying degree of inbreeding. Many of these crosses can be regarded as a form of close breeding according to Stevenson.<sup>6</sup> Secondaries were also obtained from sib-matings, confirming the observations of Stevenson<sup>5,6</sup> and Daniels<sup>4</sup> that such matings do not necessarily reduce the vigour of the offspring.

A large proportion of the secondaries were obtained from a few varieties. Arceneaux<sup>2</sup> and Stokes and Tysdal<sup>7</sup> also reported that many commercial varieties were obtained from a few parent varieties. The four varieties in the CPR are listed as parents of world varieties.<sup>2</sup> Of particular interest is the importance which Co 213 seems to have in the genealogies of the secondaries. Co 285 and POJ 2878 are less important in the ancestry. Although POJ 2878 does not seem to be valuable as a direct parent this should not detract from its importance as, in combination with varieties such as Co 285, it has produced varieties that are useful as parents.

#### Acknowledgements

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