

SELECTION OF LATE SEASON VARIETIES UNDER CONDITIONS OF HEAVY FLOWERING AT DWANGWA, MALAWI

By M. W. WHITBREAD

Dwangwa Sugar Corporation, Malawi

Abstract

The data from five trials harvested during September and October over a number of seasons were used to identify suitable late season varieties under conditions of heavy flowering at Dwangwa. The performance of 18 varieties compared with that of NCo376 is discussed in terms of tons estimated recoverable crystal per hectare per month (terc/ha/mth), tons cane per hectare (tc/ha) and estimated recoverable crystal per cent (erc%). Varieties B49119, B51129, CB4077, M124/59, Q80 and Triton were found to have better terc/ha/mth values than NCo376. NCo376 had slightly lower erc% values than most other varieties but similar cane yields. The extent of flowering was not an important factor in the selection of high yielding late season varieties.

Introduction

The Dwangwa Sugar Corporation (DSC) in Malawi is located at a latitude of 12°30'S, where conditions favour flower initiation in many sugarcane varieties. Critical daylengths of 12.5 hours occur between 9 and 17 February, and during this time soil moisture and minimum temperature also are favourable for flower initiation. Mean meteorological data for the first 20 days of February for the past eight years are as follows:

- minimum ambient temperature 21,2°C
- absolute minimum temperature 19,6°C
- rainfall 138,9 mm
- rain days 12,2

Flowering in variety NCo376 is invariably profuse if the stalks are mature enough for flower initiation.

It is generally accepted that flowering in sugarcane has detrimental effects on yield and quality at the end of the season. Since 1980, DSC has adopted two approaches to overcome the adverse effects of flowering. First was the use of chemicals to suppress flowering. Desiccating chemicals such as paraquat and diquat were found to be too severe to warrant further large-scale testing. Ethrel (a.i. ethephon), at rates of 1,5 to 2,0 l/ha, had been effective in suppressing flowering in NCo376 and giving low cane and sugar yield responses in field trials (King, 1984). However, the use of Ethrel, applied by aircraft, on an estate-wide basis appeared to give less reliable results and the practice was discontinued (Strover, 1986).

The second approach was the importation of a number of potentially shy flowering varieties for inclusion in late season variety trials. It was assumed that shy flowering varieties might perform better in terms of cane yield and erc% than heavily flowering varieties at the end of the season. The harvesting season at Dwangwa starts in mid-May at the end of the rainy season, and is usually completed by mid-November just before the start of the summer rains.

Other factors which contribute to yield and suitability for the conditions at Dwangwa need to be examined in the selection process. Climatically, conditions at Dwangwa are very

favourable for smut (*Ustilago scitaminae*), and lush grass in the drains and virgin bush in and around the estate make mosaic (Sugarcane Mosaic Virus) potentially the next most serious disease. NCo376 is very susceptible to both these diseases and an intensive inspection and roguing programme is carried out at DSC to keep them in check. The potential for smut infection is greatest during the latter part of the harvesting season, and a variety less susceptible to smut would therefore be more desirable.

Once selected as potentially suitable from the results of trials, the variety is planted in commercial fields on various soil types. Due to the flat terrain of the estate, poor drainage is a problem on some soils. After a number of seasons, the performance of the variety needs to be re-evaluated for attributes not easily assessed under trial conditions, such as acceptance by labourers.

Procedure

Since 1979 five variety trials have been established in an attempt to identify, among other things, varieties which yield well at the end of the season, using NCo376 as a standard. Details for each trial are as follows:

Trial 1: Planted 15-09-79. 4 replications. Plot size 180 m²

Varieties: NCo376, B49119, CP52-68, CP57-603, F164, M124/59, M13/56, N52/219, NCo310, Q58, Triton, Waya.

Harvested: 10-09-80, 01-10-81, 29-09-82, 27-09-83, 21-09-84, 13-09-85, 19-09-86, 29-07-87, 03-07-88.

Trial 2: Planted 30-07-82. 4 replications. Plot size 180 m².

Varieties: NCo376, B51129, Co462, Co775, D14146, F167, J59/3, N11, NCo310, Q80, Triton, Waya.

Harvested: 03-08-83, 08-08-84, 08-09-85, 09-08-86, 21-07-87, 07-07-88, 19-08-89.

Trial 3: Planted 10-09-86. 4 replications. Plot size 180 m².

Varieties: NCo376, B41227, B51129, CB4077, Co775, D14146, M124/59, N14, Q80, Triton, Waya.

Harvested: 26-08-87, 06-09-88, 11-09-89.

Trial 4: Planted 07-09-89. 8 replications. Plot size 48 m².

Varieties: NCo376, B51129, CB4077, Co62175, M124/59, N14, N15, N17, N18, Q80, R570, Triton.

Harvested: 13-09-90.

Trial 5: Planted 02-11-89. 8 replications. Plot size 48 m².

Varieties: NCo376, B41227, CB4077, CP66-346, F166, M305/51, N14, TUC6529, TUC6818, Triton, Waya, 80F2656.

Harvested: 18-10-90.

All trials were done in randomised blocks. The change in nett plot size from 180 m² to 48 m² and the increase in the

number of replications from 4 to 8 was introduced to allow for infield weighing with a load cell, reducing the time taken to weigh a trial.

The trials were located on a Valsrivier form soil (Arniston series) (MacVicar *et al.*, 1977), with an effective rooting depth of about 1,2 m during the dry months and less than 0,6 m in the wet months.

Fertilizer application rates varied between trials, but were of the following order:

Plant cane 135 kg N/ha, 60 kg P/ha, 100–200 kg K/ha.
Ratoon cane 160–190 kg N/ha.

Trials were inspected and rogued for smut and mosaic every two weeks from the time the cane reached knee height (6–8 weeks) until it was five or six months old. The number of infected stools per hectare were recorded. Herbicides were not generally used, except at planting.

All trials received supplementary flood irrigation until 25 to 30 days before harvest. A sample of 20 stalks per plot was taken immediately before harvest for sucrose analysis (DAC). At harvest a physical count was made of flowered and non-flowered stalks, and millable stalk population per plot. Harvests from September and October were used in the analysis of results, and only varieties with data for at least three harvests are discussed.

Results

The means shown at the bottom of Tables 1, 2, 3 and 4 are the averages for each variety based on the number of harvests available. The % NCo376 figure is the average percentage of the variety against NCo376 for each harvest. The mean and the % of NCo376 can be used only as an indication of the relative performance of a variety compared with NCo376. However, comparisons between varieties based on

these means and the % of NCo376 are not strictly valid because not all varieties occurred in all trials.

Ton estimated recoverable crystal per hectare per month (terc/ha/mth)

Varieties B49119, B51129, CB4077, M124/59, Q80 and Triton were significantly better than NCo376 when cut at the latter part of the season (see Table 1).

B41227, Co775, CP52–68, CP57–603, D14146, M13/56, N14, NCo310, Q58 and Waya were similar in performance to NCo376, whereas F164 and N52/219 had consistently lower values than NCo376.

B49119 and M124/59 usually performed better than the other varieties in Trial 1, although their terc/ha/mth values were not significantly better than those of Triton. In the other trials the differences between D14146, M124/59, N14, Q80, Triton and Waya were not significant.

Tons cane per hectare (tc/ha)

Only two varieties B49119 and M124/59, had obvious yield advantages over NCo376, whereas NCo376 was generally able to outyield Co775, F164, N52/219 and NCo310 (see Table 2).

All other varieties (B41227, B51129, CB4077, CP52–68, CP57–603, D14146, M13/56, N14, Q58, Q80, Triton and Waya) did not differ markedly from NCo376. NCo376 is a high population variety and this may account for its good performance in the trials.

In Trial 1, B49119 was significantly better than M124/59, which in turn had higher yields than CP52–68, CP57–603, F164, M13/56, N52/219, NCo310, Q58, Triton and Waya. Consistent yield trends between varieties in Trials 2, 3, 4 and 5 were less obvious.

Table 1

Terc/ha/mth of varieties from five trials harvested during September and October at Dwangwa.

TRIAL	Year	NCo376	B41227	B49119	B51129	CB4077	Co775	CP52–68	CP57–603	D14146	F164	M124/59	M13/56	N14	N52/219	NCo310	Q58	Q80	Triton	Waya	LSD (5%)
1	81	1,71		2,10				1,62	1,49		1,41	1,87	1,47		1,39	1,63	1,71		1,84		0,15
1	83	1,19		1,87				1,28	1,40		1,14	1,65	1,17		0,98	1,42	1,36		1,44	1,39	0,20
1	84	1,28		1,55				1,39	1,34		1,18	1,46	1,27		1,08	1,25	1,38		1,39	1,19	0,23
1	85	1,27		1,57				1,48	1,32		1,17	1,88	1,48		1,23	1,29	1,34		1,59	1,35	0,17
2	86	1,94			1,80		1,75			1,81						1,68		2,05	2,15	1,78	0,21
3	88	1,84	2,05		1,96	2,20	1,96			1,97		2,01		1,95				2,22	2,12	1,80	0,19
3	89	1,71	2,03		2,18	2,18	1,79			2,02		2,07		1,80				2,20	1,87	1,49	0,16
4	90	1,34			1,93	1,69						1,59		1,38				1,66	1,98		0,20
5	90	1,77	1,85			1,43								1,51					1,90	1,91	0,18
MEAN % NCo376		1,6	2,0	1,8	2,0	1,9	1,8	1,4	1,4	1,9	1,2	1,8	1,3	1,7	1,2	1,5	1,4	2,0	1,8	1,5	
			111,32	131,10	117,61	113,35	100,22	106,61	103,38	105,90	90,34	122,62	100,05	99,75	86,22	100,20	106,83	119,34	115,73	99,44	

Table 2

Tc/ha of varieties from five trials harvested during September and October at Dwangwa

TRIAL	YEAR	NCo376	B41227	B49119	B51129	CB4077	Co775	CP52–68	CP57–603	D14146	F164	M124/59	M13/56	N14	N52/219	NCo310	Q58	Q80	Triton	Waya	LSD (5%)
1	81	159,6		189,2				130,5	131,2		126,2	171,0	133,0		114,7	142,3	149,1		152,1		13,7
1	83	109,7		169,2				113,6	114,6		96,1	141,9	102,6		84,6	113,2	115,8		120,7	118,0	15,0
1	84	102,9		136,8				115,3	108,4		93,6	120,7	100,3		86,4	93,2	105,3		103,8	100,4	16,1
1	85	113,9		132,6				119,0	110,3		92,8	148,5	122,5		93,1	101,1	101,8		119,6	108,4	12,7
2	86	145,8			118,3		121,7			138,3						120,1		135,4	141,9	124,6	20,7
3	88	152,0	156,0		153,8	166,0	150,8			164,0		159,3		174,5				163,3	153,5	137,5	14,0
3	89	144,3	140,0		150,7	174,8	127,7			153,3		165,5		155,5				137,5	133,3	116,3	15,2
4	90	111,5			142,9	130,5						123,2		115,2				122,4	145,2		14,6
5	90	138,2	141,2			112,8								129,1					143,4	149,9	11,8
MEAN % NCo376		131,0	145,7	157,0	141,4	146,0	133,4	119,6	116,1	152,6	102,2	147,2	114,6	143,6	94,7	114,0	118,0	139,7	134,8	122,2	
			100,40	130,57	103,60	107,11	90,22	100,49	97,24	103,32	84,82	116,25	95,49	104,67	78,69	90,83	97,70	101,20	102,96	94,99	

Estimated recoverable crystal per cent (erc%)

The values of erc% for the different varieties, when expressed as a percentage of NCo376, showed that they were generally slightly better than NCo376 (see Table 3). Values for varieties B41227, B51129, Co775, F164, M13/56, N52/219, Q58, Q80 and Triton were consistently above those for NCo376, although not always significantly different. N14 only was consistently below NCo376.

B41227, B51129, Q80 and Triton had the highest erc% values for Trial 1 harvests, and N14 the lowest values for Trials 2, 3, 4 and 5.

Flowering

Percentage flowering of NCo376 was comparable with that of Co775, CP52-68, CP57-603, D14146, F164, M124/59, M13/56, N14, N52/219, NCo310 and Q58 (see Table 4). Varieties B41227, B49119, B51129, CB4077, Q80 and Waya were shy flowering varieties.

If NCo376 was planted towards the end of October, it recorded a lower flower percentage than the usual value of over 90%. If N14 was planted towards the end of October it tended to flower more heavily than NCo376.

Linear regressions were calculated on the data and there was no evidence to suggest that shy flowering varieties were better yielding in terms of terc/ha/mth ($r^2 = 0,07$), tc/ha ($r^2 = 0,02$) and erc% ($r^2 = 0,04$). Heavily flowered NCo376 was often able to produce cane yields similar to those of the shy flowering varieties, except for B49119.

Millable stalks per hectare

Millable stalk population for the different varieties, expressed as a percentage of NCo376, were as follows:

B41227	- 71,6%	M124/59	- 98,6%
B49119	- 102,6%	M13/56	- 100,4%
B51129	- 60,2%	N14	- 99,2%
CB4077	- 50,6%	N52/219	- 80,6%
Co775	- 63,0%	NCo310	- 94,5%
CP52-68	- 92,0%	Q58	- 87,5%
CP57-603	- 93,3%	Q80	- 41,7%
D14146	- 72,9%	Triton	- 75,3%
F164	- 78,1%	Waya	- 67,4%

NCo376 had a population considerably greater than most other varieties, especially the shy-flowering ones. B49119 only had a population slightly greater than that of NCo376 although M124/59, M13/56, N14 and NCo310 had similar millable stalk populations to NCo376.

Discussion

Most varieties have not been in the trial programme long enough for true assessment of their potential or longevity. However, results to date show that varieties alternative to NCo376 are available to increase sugar yield at the end of the season, some of which are shy flowering. Despite flowers emerging at Dwangwa in mid-April, some 4-5 months before expected harvest in heavily flowering varieties like Triton, there was little correlation between yield and flowering.

Table 3

Erc % of varieties from five trials harvested during September and October at Dwangwa

TRIAL	YEAR	NCo376	B41227	B49119	B51129	CB4077	Co775	CP52-68	CP57-603	D14146	F164	M124/59	M13/56	N14	N52/219	NCo310	Q58	Q80	Triton	Waya	LSD (5%)
1	81	13,43		13,90				15,52	14,19		13,93	13,67	13,84		15,20	14,36	14,30		15,12		0,98
1	83	12,98		13,23				13,47	14,63		14,20	13,95	13,67		13,90	15,10	14,13		14,32	14,12	1,10
1	84	14,70		13,37				14,19	14,62		14,84	14,28	14,96		14,76	15,84	15,41		15,82	13,99	1,02
1	85	13,19		13,99				14,67	14,17		14,82	14,90	14,29		15,58	15,06	15,58		15,73	14,69	0,84
2	86	14,65			16,73		15,83			14,40						15,40		16,51	16,65	15,05	1,14
3	88	14,84	16,16		15,69	16,17	15,98			14,74		15,55		13,74				16,70	16,98	16,06	1,28
3	89	14,49	17,66		17,63	15,32	17,06			15,85		15,28		14,16				19,53	17,10	15,64	1,19
4	90	13,82			15,56	14,91						14,85		13,79				15,61	15,71		0,93
5	90	14,76	15,10			14,60								13,41					15,21	14,69	1,16
MEAN %		14,10	16,31	13,62	16,40	15,25	16,29	14,46	14,40	15,00	14,45	14,64	14,19	13,78	14,86	15,15	14,86	17,09	15,85	14,89	
NCo376			111,03	100,61	113,55	105,37	111,16	106,77	106,31	102,34	106,61	105,29	104,62	95,24	109,70	110,06	109,57	118,24	112,44	104,82	

Table 4

Flowering % of varieties from five trials harvested during September and October at Dwangwa

TRIAL	YEAR	NCo376	B41227	B49119	B51129	CB4077	Co775	CP52-68	CP57-603	D14146	F164	M124/59	M13/56	N14	N52/219	NCo310	Q58	Q80	Triton	Waya
1	81	95,1		37,5				91,1	92,5		93,2	92,8	93,5		91,9	94,2	92,3		93,9	
1	83	95,5		0,8				95,6	94,4		96,2	94,9	92,8		94,6	91,2	91,2		92,8	1,6
1	84	91,6		1,4				88,4	86,6		86,9	80,8	78,1		78,2	89,4	92,9		94,1	12,0
1	85	97,4		14,9				96,7	32,6		93,9	91,2	94,1		87,4	91,9	95,5		97,0	5,5
2	86	92,4			14,4		97,4			92,6						98,6		25,1	82,6	15,5
3	88	95,6	5,9		0,2	22,6	95,0			26,6		90,8		93,0				0,1	27,9	4,9
3	89	95,2	35,2		29,3	0,1	88,7			91,6		91,6		94,5				11,1	83,9	19,1
4	90	46,9			0,4	0,6						4,7		90,3				0,0	44,6	
5	90	0,7	0,0			0,1								73,0					8,2	0,0
MEAN %		78,9	13,7	13,6	11,1	5,9	93,7	93,0	76,5	70,3	92,3	78,1	89,6	87,7	88,0	93,1	93,0	9,1	69,4	8,4
NCo376			14,38	14,25	11,86	9,83	99,32	97,92	81,04	74,75	97,50	82,85	94,34	2704,4	92,70	98,64	98,01	9,73	87,98	8,91

This suggests that research on alternatives for the later part of the harvesting season should not be limited to shy flowering varieties.

At Dwangwa smut and mosaic are potentially serious diseases and varieties are regularly inspected for infection. NCo310 and B49119 were found to have the same or more stools infected with smut than NCo376, and were phased out. The introduction of better performing varieties, such as B51129 and CB4077, has contributed to the reduction in smut incidence on the estate. This allowed more time for roguing problem varieties such as NCo376. Mosaic did not often occur in the trials. It is therefore difficult to comment on the relative susceptibility to mosaic of the trial varieties, but commercial field plantings have indicated that mosaic can be found in most varieties, particularly N14.

Because of its good performance in the trials, M124/59 has been planted on a limited basis in commercial fields. It was found, however, that labourers were reluctant to cut this variety because of its lodging and intertwined stalks. B51129 has shown a tendency to brittle stalks, resulting in haulage losses from commercial fields.

The continuation of trials to identify promising varieties, the planting of such varieties in commercial fields for further assessment, and a review of the cultural practices now being adopted at Dwangwa are considered as ways of improving late season yields.

Some new varieties are already in the varietal testing programme and, of these, Co62175 and two pre-release varieties from Mount Edgecombe (80F2147 and 80F3274) appear promising.

Cultural improvements envisaged are:

- A re-examination of methods of applying Ethrel to NCo376 to suppress flowering. NCo376 has been shown to have reasonably good cane yields but low *erc%* values at the end of the season, and King (1984) demonstrated that the suppression of flowering improved both yield and quality in this variety at Dwangwa
- Ripening of shy flowering varieties
- Selection of varieties suitable for the different soil types at Dwangwa
- Improved drainage. The arrival of the heavy summer rains (long term mean 1 400 mm) results in lower evaporation, lower radiation, a decline in temperature and a considerable reduction in effective rooting depth. Late cut fields are therefore severely disadvantaged compared with the

early harvested fields, which have had more favourable growing conditions. Improved drainage in late cut fields should reduce the poor growing conditions. However, the flat terrain of the Dwangwa delta makes drainage improvements very difficult.

Conclusion

Six trial varieties (B49119, B51129, CB4077, M124/59, Q80 and Triton) performed better than NCo376 in terms of *terc/ha/mth*. Of these, four were shy flowering. The two remaining varieties, M124/59 and Triton, tended to have high flowering percentages.

The *erc%* values of NCo376 were similar to or lower than most varieties considered. However, with the exception of B49119 and M124/59, NCo376 was able to produce cane yields equal to or better than the eighteen varieties discussed. The high population of NCo376 is likely to have contributed to this result.

The very low coefficients obtained for linear regressions of per cent flowering on *terc/ha/mth*, *tc/ha* and *erc%* indicate that degree of flowering is not a reliable factor on its own when considering selection of varieties for late season conditions at Dwangwa.

Sucrose yields cannot be looked at in isolation in the identification of suitable late season varieties to replace NCo376. Other agronomic factors also require consideration.

Acknowledgements

Previous agronomists at DSC, in particular Mr PM Strover, laid the ground work for the variety programme now being implemented. The assistance of staff of the Agronomy department at DSC in obtaining the data is appreciated. The South African Sugar Association has greatly assisted DSC in obtaining potentially suitable varieties.

REFERENCES

- King, AG (1984). Internal documentation, Dwangwa Sugar Corporation, Malawi.
- MacVicar, CN, de Villiers, JM, Loxton, RF, Verster, E, Lambrechts, JJN, Merryweather, FR, le Roux, J and van Rooyen, NTH (1977). Soil Classification. A Binomial system of South Africa. Pretoria. Department of Agricultural Technical Services.
- Strover, PM (1986). Internal documentation, Dwangwa Sugar Corporation, Malawi.