

AN EVALUATION OF SUGARCANE VARIETY N19 UNDER RAINFED CONDITIONS IN THE SOUTH AFRICAN SUGAR INDUSTRY

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Abstract

The variety N19, originally released in northern irrigated areas only, was released in selected regions of the southern rainfed area of the industry in 1989. It was planted in the Agronomy variety programme in 12 trials at sites representing a range of soils and climatic conditions. Trial results in terms of yield, cane quality, selected agronomic characteristics and reaction to *Eldana saccharina* Walker are compared with those of NCo376 and other commercial varieties. N19 shows promise as a variety for annual harvesting in areas where mosaic disease is not a problem.

Keywords: Variety, N19, field trials, rainfed.

Introduction

Variety N19, bred from parents NCo376 and CB40/35, was originally released in the northern irrigated areas of the industry in 1986. Relative to varieties NCo376 and N14, it has a high sucrose content which is more marked early in the season and it has good resistance to smut disease. At Pongola mill in the 1994-95 season, 40% of throughput by weight was N19 (Lionnet, 1995).

N19 was planted in six variety trials conducted by the Plant Breeding department of the South African Sugar Association Experiment Station (SASEX) in the southern rainfed area of the industry in 1982. Sites included Mtunzini, Shakaskraal, La Mercy, Mount Edgecombe, Central Field Station (CFS) and Windyhill. The results (Plant Breeding, unpublished data) showed that, with the exception of the CFS site on coastal sands and one crop at Shakaskraal, N19 outyielded NCo376 over the 16 crops harvested, giving a sucrose content of 1,6 units higher than NCo376 and yielding 8,9% more sucrose per hectare.

N19 proved to be a relatively hardy variety under dryland conditions and was subsequently released in selected areas of the south in 1989. Susceptibility to mosaic disease is the reason for its exclusion from the Midlands and South coast regions. Characteristics such as rapid stalk elongation and a high sucrose content suggested that it could be useful as a variety for annual harvesting, particularly at the start of the season.

Due to the number of varieties in the breeding and selection programmes no further evaluation is conducted by the Plant Breeding department after release of a new variety. However, released varieties are routinely included in the Agronomy department variety programme for further evaluation. The main objectives are to compare the performance of new varieties with currently grown varieties in as wide a range of soil and climatic conditions as possible, in order to provide extension and growers with relevant and updated information.

Since 1987, variety N19 has been included in 12 trials conducted in the southern rainfed section of the Agronomy vari-

ety programme. Results from 26 harvested crops in terms of yield, cane quality, reaction to eldana borer and selected agronomic characteristics are discussed in this paper.

Method

Selected details of trials conducted on 12 sites representative of the main sugar growing regions of KwaZulu-Natal are presented in Table 1. With the exception of the Dalton and Nkwalini trials which were irrigated, and the Empangeni trial where supplementary irrigation was applied, the trials were rainfed. Rainfall data were obtained from Experiment Station records of nearby meteorological stations.

Table 1
Selected details of N19 trial sites

Trial		Site	Region	Topography	Soil		
No.	Code				Form	Depth	Clay %
1	RVT CN9	Ottawa	North Coast	Crest	Milkwood	Shallow	44
2	RVT CN10	Ottawa	North Coast	Crest	Milkwood	Shallow	44
3	EVT 24	Gingindhlovu	Zululand	Lower slope	Westleigh	Med/Shallow	8
4	RVT C26	Mtunzini	Zululand	Upper slope	Shortlands	Deep	59
5	EVT 19	Empangeni	Zululand	Mid slope	Hutton	Medium	>30
6	EVT 17	Nkwalini	Zululand	Valley	Katspruit	Shallow	>40
7	EVT 12	Monzi	Umfolozi	Flat	Bonheim	Shallow	>30
8	EVT 21	Uloa	Umfolozi	Flat	Oakleaf	Med/Deep	>30
9	EVT 22	Equeefa	South Coast	Valley	Dundee	Deep	<29
10	RVT CH5	Paddock	South Coast	Mid slope	Longlands	Medium	16
11	RVT MBS	Jaagbaan	Midlands	Upper slope	Hutton	Deep	32
12	EVT 23	Dalton	Midlands	Lower slope	Hutton	Deep	21

While all field trials were planted and harvested by the Agronomy department, the management of field operations such as fertiliser application and weed control was divided into two categories, viz Regional Variety Trials (RVT) and Estate Variety Trials (EVT). The former are managed by the Agronomy department and the latter by grower co-operators as per farm practices. Seven trials fall into the EVT category and five trials into the RVT category.

NCo376 and N12, with the exception of N12 in the Monzi trial, were included as standards for measurement of yielding ability and other traits. Variety NCo376 was included in all 12 trials, N12 in 11 trials, N16 and N21 in nine trials, N17 in eight trials and N14 and NCo310 in two trials. Field trials were established according to randomised block or latin square design and replicated five or six times. Plot size ranged from five to eight rows of eight to ten metres in length. At harvest the guard rows on each side of the nett plot and 0,5 to 1,0 m at the end of the nett rows were discarded for growth measurements and recording of cane yield, and 12 of the harvested cane stalks in each plot were taken for sucrose analysis. Sampling for sucrose content was conducted on 41 occasions prior to and at harvest.

In making the comparison of N19 with that of another variety with regard to the average sucrose contents and yields,

only those crops in which both varieties were represented have been included.

An assessment of the level of eldana damage in each variety was made at harvest. A random sample of 25 to 50 stalks was chosen from each plot, the stalks split lengthways and records made of the number of joints, damaged joints and eldana per stalk.

Differences in lodging in varieties were recorded prior to harvest. A visual assessment of the cane was made and severity of lodging rated on a scale of one to nine, where one indicated that no lodging was present (upright cane) and nine indicated that all cane stalks had fallen over.

Trials 1-9 were located in the coastal regions of the industry and, with the exception of trial number 9 (Equeefa), were conducted within areas where N19 is permitted for planting.

Trials 10-12 were conducted in the hinterland and Midland regions where N19 may not be planted commercially due to mosaic. Components of yield and discussion from the 26 crops harvested from these trials follow in the paper.

Results and discussion

Sucrose content, cane and sucrose yield from 26 harvested crops are given in Appendix 1.

Sucrose content

Figure 1 shows the sucrose content of N19 expressed as a percentage of NCo376. The mean of all (41) sucrose samples was 11% (1,26 units) higher than that of NCo376 and the mean sucrose content of samples taken in May was 16% (1,5 units) greater in N19 than in NCo376. Table 2 shows the average sucrose content of N19 compared with that of other varieties harvested at the same time.

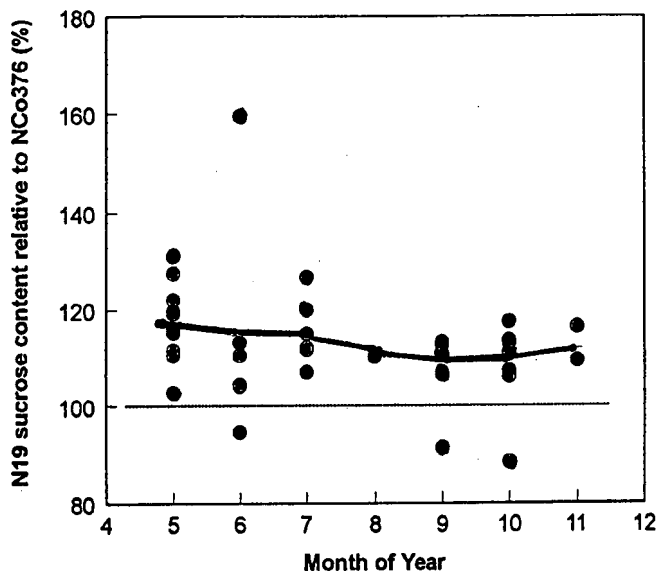


FIGURE 1: Sucrose content of N19 expressed as a percentage of NCo376 (monthly means as solid line)

Table 2

Comparison of average sucrose content (pol % cane) of N19 with other varieties

Variety	NCo376	N12	N16	N17	N21
No of crops	26	22	16	15	17
Average pol % cane N19	12,6	12,1	11,9	12,8	12,6
Average pol % cane Variety	11,3	11,1	10,7	12,6	11,9
Difference from N19	-1,3 (11%)	-1,0 (8%)	-1,2 (10%)	-0,2 (2%)	-0,7 (5%)
SED	0,18	0,25	0,23	0,29	0,24

Cane yield

The mean cane yield of N19 was 7% less than N16, 5% less than NCo376 and N12 and was similar to that of N17 and N21.

Sucrose yield

Figure 2 shows the sucrose yield of N19 expressed as a percentage of NCo376 when grown under identical conditions. N19 outyielded NCo376 in 17 of the 26 crops harvested and in five crops the sucrose yield was only slightly less (0,1-0,3 sucrose t/ha) than NCo376. The four crops in which yields of N19 were inferior (0,6-1,7 sucrose t/ha) to NCo376 were all from the Paddock site (trial 10) conducted on a relatively poor, sandy loam soil on the lower south coast hinterland.

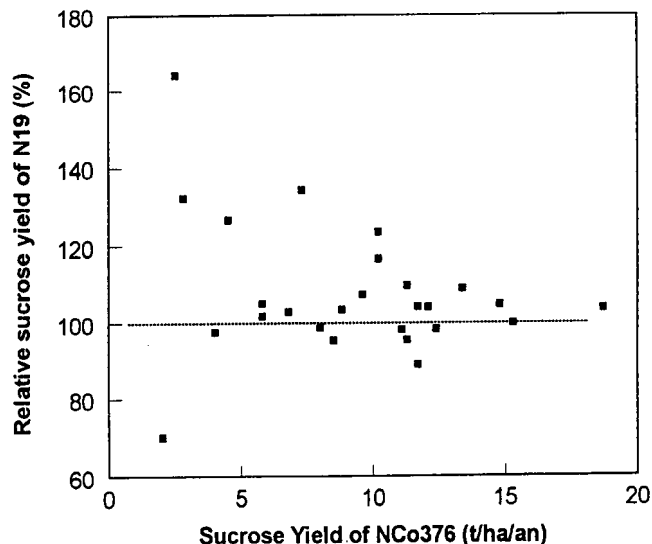


FIGURE 2: Sucrose yield of N19 compared with that of NCo376

Table 3 shows the comparison of the sucrose yields of varieties NCo376, N12, N16, N17 and N21 expressed as a percentage of N19 in the 12 trials. A summary of the average sucrose yield of N19 relative to those varieties is shown in Table 4.

N19 gave an average sucrose yield of 16% (2,4 sucrose t/ha) more than N14 in the two trials (numbers 7 and 8) conducted on the Umfolozi flats. Variety NCo310, despite a high sucrose content (14,9%), similar to that of N19, yielded 12% less cane and produced a mean of 10% (1,2 sucrose t/ha) less sucrose than N19 in the two trials (numbers 3 and 7).

Table 4

Comparison of average sucrose yield (sucrose t/ha) of N19 with other varieties

Variety	NCo376	N12	N16	N17	N21
No of crops	26	22	16	15	17
Average sucrose (t/ha) N19	11,64	11,54	10,05	11,35	11,15
Average sucrose (t/ha) Variety	11,10	11,15	9,84	11,04	10,66
Difference from N19	-0,54 (5%)	-0,39 (3%)	-0,21 (2%)	-0,31 (3%)	-0,49 (4%)
SED	0,21	0,34	0,26	0,31	0,26

Reaction to environmental conditions

Although subjected to limited testing under the particularly harsh conditions during the recent drought, N19 has proved to be a relatively hardy variety. However, there are indications that performance can be adversely affected by moisture stress. The plant crop of trial 2 (Ottawa), sited on a shallow

Table 3
Sucrose yield of varieties expressed as a percentage of N19 in 12 trials

Trial	Site	Crop	Dates month/year	Age (months)	Rain (mm)	% LTM	Sucrose yield (ts/ha) N19	N19	Performance of varieties (ts/ha) expressed as a % of N19 = 100%				
									NCo376	N12	N16	N17	N21
1	Ottawa	P	02.94-05.95	15,2	1224	87	(4,1)	100	61*	68*	73	68*	112
2	Ottawa	P	10.94-10.95	11,4	828	99	(5,6)	100	98	114	114	113	120*
3	Gingindhlovu	P	09.94-09.95	12,1	843	83	(10,3)	100	93	94	100	92	90
4	Mtunzini	P	01.94-07.95	17,5	1570	81	(10,2)	100	97	93	93	79*	87*
5	Empangeni	P	10.92-10.93	11,9	611	62	(3,8)	100	103	84	87	82	100
5	Empangeni	R1	10.93-10.94	12,0	823+	Irrig	(14,6)	100	92	80	101	101	97
5	Empangeni	R2	10.94-10.95	11,7	1084	108	(15,1)	100	95	89	102	103	104
6	Nkwalini	P	09.93-09.94	12,2	Irrig		(12,8)	100	96	86	114	110	90
6	Nkwalini	R1	09.94-09.95	11,6	Irrig	(Deficit)	(7,6)	100	103	107	91	142*	109
7	Monzi	P	11.90-10.91	11,9	1152	126	(12,2)	100	102	-	-	97	94
7	Monzi	R1	10.91-10.92	11,5	371	45	(11,4)	100	86	-	-	107	105
7	Monzi	R2	10.92-09.93	11,5	496	54	(12,1)	100	81*	-	-	93	98
7	Monzi	R3	09.93-10.94	12,7	968	96	(13,1)	100	92	-	-	94	89
8	Uloa	P	03.93-05.94	13,8	890	86	(22,3)	100	97	83*	-	88*	87*
8	Uloa	R1	05.94-05.95	11,9	969	106	(15,1)	100	101	70*	-	89	103
9	Equeefa	P	11.93-05.95	17,1	1210	103	(14,0)	100	74*	86	86	-	84
10	Paddock	P	03.86-06.87	15,1	1328	100	(13,6)	100	104	88*	90	-	-
10	Paddock	R1	06.87-11.88	16,8	2181	151	(11,3)	100	105	96	91	-	-
10	Paddock	R2	11.88-10.89	10,9	782	84	(11,1)	100	95	103	98	-	-
10	Paddock	R3	10.89-07.91	21,2	1781	90	(18,9)	100	109	123*	107	-	-
10	Paddock	R5	08.92-07.94	23,1	1549	71	(2,6)	100	146*	204*	150*	-	-
11	Jaagbaan	P	11.85-11.87	23,4	2020	118	(17,8)	100	97	90	-	-	-
11	Jaagbaan	R1	11.87-07.89	20,3	1517	114	(18,5)	100	102	130*	-	-	-
11	Jaagbaan	R2	07.89-06.91	23,4	1543	97	(11,9)	100	95	118	-	-	-
11	Jaagbaan	R3	06.91-07.93	24,3	1096	68	(7,4)	100	76*	116	-	-	-
12	Dalton	P	08.94-07.95	11,1	Irrig		(5,3)	100	79*	53*	70*	-	85

clay soil overlying shale, started in favourable conditions and all varieties grew well, but the three months prior to harvest in October were very dry (15% of LTM) and N19 showed early visual signs of stress. Sucrose sampled two months prior to and at harvest showed that juice purity in N19 dropped from 77% to 66% between 9,4 and 11,4 months of age and sucrose content remained low (10,8% and 10,6%). In comparison the sucrose content of N12 increased from 10,0% to 13,4% and purity remained constant (74% to 77%) over the same period of time. Some stalks of N19 were slightly pithy at harvest, a feature not noted in stalks of N12.

At the Nkwalini site (trial 6), which was also sited on a shallow soil with low water holding capacity, low rainfall (520 mm) and insufficient irrigation resulted in a first ratoon crop that was stressed during three summer months and in the three months prior to harvest in September. In comparison with N17, the top yielding variety in this crop, N19 yielded 15 tc/ha less and the sucrose content was 1,7 units lower.

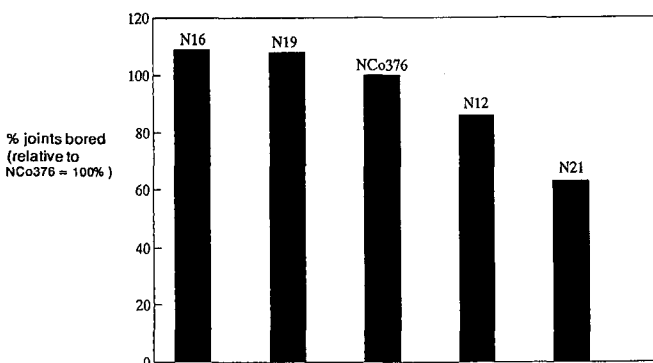
N19 performed consistently well at the Monzi site (trial 7) which is on a relatively shallow clay topsoil. The first and second ratoon crops were subjected to very low rainfall seasons (45% and 54% of LTM), but had the advantage of a watertable at depth.

In general, the performance of N19 relative to other varieties has been good at sites where periods of moisture stress have not been long and where soils are of a moderate depth and clay content is above 20%.

Reaction to Eldana saccharina Walker

Recordings of *E. saccharina* infestation and damage, measured in eldana per 100 stalks (e/100) and per cent joints bored (%JB) respectively, were made on 18 harvested crops. In terms of trial means, infestation ranged from 0,1 to 61 e/100 and damage from 0,4 to 33% JB.

Damage in each variety was measured and expressed as a percentage of that of NCo376 (Figure 3). The mean level of damage in N19 was 7,9% JB which was similar to N16, slightly worse than NCo376 and nearly double that of N21, a variety released and known for its resistance to *E. saccharina* (McIntyre *et al.*, 1994).



Relationship between level of eldana damage in N19 and other varieties grown under identical conditions.

FIGURE 3: Relationship between level of eldana damage in N19 and other varieties grown under identical conditions

Response to Ripeners

Four years of testing have shown that the combination treatment of Ethrel and Fusilade is the treatment of preference above that of single Ethrel or Fusilade treatments for ripening N19 (Donaldson, 1996).

Crop characteristics

In comparison with NCo376, the stalk population of N19 is on average 17% less and ranges between 95 000 and 115 000/ha, while stalk mass is 16% heavier (65 g/m) and stalk length is 14% greater (22 cm).

N19 germinates quickly and stalk elongation is rapid. An example of this was in trial 1 at Ottawa, planted in February in dry and hot conditions which persisted through to early March. It is interesting that only varieties N19 and N21 germinated well under these adverse conditions and the substantial differences in growth noted in the early crop stage persisted through to harvest.

N19 is prone to early lodging and stalks tend to be crooked. Assessments of lodging made in 22 crops showed that lodging in N19 is likely to be twice as severe as in NCo376 at all levels.

The average fibre content of N19 cane was 12%, which was similar to that of NCo376.

Conclusions

The results of this series of trials have shown that N19, with a few exceptions, has performed well over a wide range of soil and climatic conditions in the rainfed areas of the industry. In general, results confirm earlier selection data and recommendations regarding this variety. Under favourable conditions N19 has the capacity to produce a high sucrose yield in a relatively short period of time. Its high sucrose content relative to most established varieties, a feature which is more marked early in the season, makes it useful as a variety for early season harvesting.

Caution with N19 is necessary in the southern parts of the industry, however, as it is susceptible to mosaic. Although performance of N19 in some crops harvested at 15-17 months was good, factors such as susceptibility to eldana and a tendency to lodge make it a variety not suitable for carry-over cane. It is a relatively hardy variety but is best suited to medium to favourable conditions. Planting should be avoided on shallow, poor or sandy soils with low water holding capacity where stress is likely to occur.

Its potential for rapid growth, good resistance to smut and its high sucrose make it suitable for annual harvesting, particularly in the lower altitudes and coastal areas of the north coast and Zululand.

Acknowledgements

Sincere thanks are due to the many growers for their excellent co-operation and help and to Experiment Station colleagues for their hard work and valuable assistance.

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Appendix 1: Comparison of yield of N19 with other varieties in trials 1-12

Trial	Site	Harvest date (mnth/yr)	Age (mths)	Crop	Component	N19	NCc376	N12	N18	N17	N21	LSD 0,05
1	Ottawa North Coast	5,95	15,2	P	Cane t/ha	51	38	42	43	41	56	10
					Pol% cane	7,9	8,8	8,8	8,8	8,7	8,3	1,1
					sucrose t/ha	4,1	2,5	2,8	3,0	2,8	4,6	1,2
2	Ottawa North Coast	10,95	11,4	P	Cane t/ha	53	46	48	55	46	56	7
					Pol% cane	10,6	12,0	13,4	11,7	13,8	11,8	1,4
					sucrose t/ha	6,6	5,5	6,4	6,4	8,3	6,7	1,0
3	Gingindhlovu Zululand	9,95	12,1	P	Cane t/ha	67	71	70	78	62	60	10
					Pol% cane	15,3	13,5	13,9	13,2	15,3	15,6	0,8
					sucrose t/ha	10,3	9,8	9,7	10,3	9,5	8,3	1,4
4	Mtunzini Zululand	7,95	17,5	P	Cane t/ha	82	84	81	85	80	82	10
					Pol% cane	12,4	10,6	11,8	10,9	10,1	10,8	1,1
					sucrose t/ha	10,2	9,9	9,5	9,5	8,1	8,8	1,2
6	Empangeni Zululand	10,83	11,9	P	Cane t/ha	33	41	35	35	30	37	8
					Pol% cane	11,4	9,7	8,1	9,3	10,5	10,3	0,7
					sucrose t/ha	3,8	3,8	3,2	3,3	3,1	3,8	1,0
6	Empangeni Zululand	10,94	12,0	R1	Cane t/ha	93	97	83	102	88	93	18
					Pol% cane	15,7	13,8	14,2	14,5	15,1	15,3	1,3
					sucrose t/ha	14,6	13,4	11,7	14,8	14,8	14,2	3,1
6	Empangeni Zululand	10,95	11,7	R2	Cane t/ha	92	99	93	111	100	99	13,0
					Pol% cane	16,4	14,5	14,5	13,9	15,8	15,8	1,0
					sucrose t/ha	15,1	14,4	13,5	15,4	15,6	15,7	2,2
6	Nkwalini Zululand	9,94	12,2	P	Cane t/ha	88	88	75	101	84	76	20
					Pol% cane	14,9	14,0	14,8	14,5	15,1	15,1	0,7
					sucrose t/ha	12,8	12,3	11,0	14,6	14,1	11,5	3,0
6	Nkwalini Zululand	9,95	11,6	R1	Cane t/ha	66	60	68	65	71	66	14
					Pol% cane	13,7	12,8	14,1	12,4	15,3	14,9	1,5
					sucrose t/ha	7,6	7,8	8,1	6,9	10,8	8,3	2,3
7	Monzi Umfolozi	10,81	11,9	P	Cane t/ha	85	94	-	-	86	85	8
					Pol% cane	14,5	13,1	-	-	13,7	13,6	0,7
					sucrose t/ha	12,2	12,4	-	-	11,8	11,5	1,3
7	Monzi Umfolozi	10,82	11,5	R1	Cane t/ha	76	73	-	-	82	80	10
					Pol% cane	14,9	13,4	-	-	14,9	14,9	1,0
					sucrose t/ha	11,4	9,8	-	-	12,2	12,0	1,7
7	Monzi Umfolozi	9,93	11,5	R2	Cane t/ha	82	71	-	-	75	80	8
					Pol% cane	14,8	13,8	-	-	14,9	14,9	0,8
					sucrose t/ha	12,1	9,8	-	-	11,2	11,9	1,8
7	Monzi Umfolozi	10,94	12,7	R3	Cane t/ha	93	89	-	-	88	90	12,0
					Pol% cane	14,1	13,3	-	-	14,0	13,0	1,2
					sucrose t/ha	13,1	12,0	-	-	12,3	11,8	2,0
8	Uloa Umfolozi	6,94	13,8	P	Cane t/ha	154	187	140	-	141	151	18
					Pol% cane	14,5	13,0	13,4	-	14,0	12,9	0,8
					sucrose t/ha	22,3	21,8	18,8	-	19,7	18,5	2,5
8	Uloa Umfolozi	6,95	11,9	R1	Cane t/ha	133	166	134	-	134	164	21
					Pol% cane	11,3	9,8	7,8	-	10,1	10,1	1,2
					sucrose t/ha	15,1	15,2	10,6	-	13,4	15,6	2,8
9	Equeefa South Coast	6,95	17,1	P	Cane t/ha	108	101	115	109	-	106	17
					Pol% cane	13,0	10,2	10,3	11,1	-	11,1	1,2
					sucrose t/ha	14,0	10,4	12,0	12,1	-	11,7	2,5
10	Paddock South Coast Hinterland	6,87	15,1	P	Cane t/ha	99	96	84	90	-	-	12
					Pol% cane	13,9	14,7	14,2	13,8	-	-	1,0
					sucrose t/ha	13,6	14,2	12,0	12,3	-	-	2,1
10	Paddock South Coast Hinterland	11,88	16,8	R1	Cane t/ha	69	78	77	69	-	-	8
					Pol% cane	16,4	15,1	14,0	14,9	-	-	0,8
					sucrose t/ha	11,3	11,9	10,8	10,3	-	-	1,5
10	Paddock South Coast Hinterland	10,89	10,9	R2	Cane t/ha	75	80	78	78	-	-	7
					Pol% cane	14,9	13,2	14,6	14,0	-	-	0,8
					sucrose t/ha	11,1	10,6	11,4	10,9	-	-	1,0
10	Paddock South Coast Hinterland	7,91	21,2	R3	Cane t/ha	119	148	160	137	-	-	16
					Pol% cane	15,7	14,0	14,5	14,8	-	-	0,8
					sucrose t/ha	18,9	20,8	23,2	20,2	-	-	2,8
10	Paddock South Coast Hinterland	7,84	23,1	R6	Cane t/ha	27	44	51	46	-	-	8
					Pol% cane	9,8	8,8	10,1	8,7	-	-	1,0
					sucrose t/ha	2,6	3,8	5,3	3,9	-	-	1,1
11	Jaagbaan Midlands	11,97	23,4	P	Cane t/ha	121	135	124	-	-	-	11
					Pol% cane	14,8	12,7	13,0	-	-	-	0,7
					sucrose t/ha	17,8	17,2	16,1	-	-	-	1,8
11	Jaagbaan Midlands	7,89	20,3	R1	Cane t/ha	120	131	166	-	-	-	17
					Pol% cane	15,4	14,4	14,8	-	-	-	0,4
					sucrose t/ha	18,5	18,8	24,1	-	-	-	2,6
11	Jaagbaan Midlands	6,81	23,4	R2	Cane t/ha	82	87	105	-	-	-	13
					Pol% cane	14,6	12,9	13,3	-	-	-	0,7
					sucrose t/ha	11,9	11,3	14,0	-	-	-	2,1
11	Jaagbaan Midlands	7,93	24,3	R3	Cane t/ha	64	48	62	-	-	-	9
					Pol% cane	13,8	11,5	13,8	-	-	-	0,8
					sucrose t/ha	7,4	5,6	8,6	-	-	-	1,4
12	Dalton Midlands	7,95	11,1	P	Cane t/ha	93	92	80	96	-	84	10
					Pol% cane	6,7	4,5	3,5	3,9	-	4,7	0,8
					sucrose t/ha	6,3	4,2	2,8	3,7	-	4,5	0,8