THE COMPUTER ANALYSIS OF FARM RECORDS FROM AN EXTENSION AREA

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Abstract

The collection and computer analysis of farm field records and the results obtained are described.

Introduction

The SASA Experiment Station has recognised that the difference between present industrial yields and achievable yields is partly due to a lack of application of sound management principles. Proper planning and control are essential to good management, and they are only feasible when reliable data and records are available. The degree to which good records are kept varies tremendously from farm to farm and, even when comprehensive records are kept, they are often not analysed to provide meaningful information. The advantages of computerisation of farm records may occur in a number of ways :

(a) *On the farm :*

(i) Some growers keep only the minimum records required by industry, but even these can produce meaningful data and form the basis of a record system after computerisation and analysis.

(ii) The availability of meaningful data can result in better decision-making and planning and control procedures.

(b) *Between farms :*

(i) Between farm comparisons in homogeneous areas will enable growers to set meaningful objectives.

(ii) Growers will be able to pinpoint areas of below-average performance on their own farms.

(c) *Extension :*

(i) Data for his own region will enable an Extension Officer to identify problem areas and to deal with them more effectively.

(ii) The Extension Officer can become more deeply involved on the individual farm and thereby improve his effectiveness in other aspects of extension as well.

Method

The computerisation of farm records is the Extension Project for the Durban North Coast extension area. This paper deals with the processing of data from the first 37 farms. Each grower was contacted personally and the aims of the programme explained to him. He was then asked to complete the data sheet (Appendix 1) after the necessary headings had been filled in by the Extension Officer. The complexity of the data sheet depended upon the amount of raw data the grower could offer. After gaining some idea of the variation in the type of records kept, a more standard data sheet (Appendix 2) was introduced, and this made it easier to punch the data into the computer.

Growers were encouraged to provide records from previous seasons so that the data would be of more immediate benefit and validity. The data that was most commonly offered by growers included :

Name/number of field.
Ratoon.
Variety.
Soil type.
Field size.
Age at harvest.
Total tons cane.

Additional data offered by some growers included :

Split vs non split fertilization.
Trash vs burn.
Nematicide vs no Nematicide.
Crest vs valley bottoms.
Organic vs inorganic fertilization.
Mature vs seasonal cane.
Stack weight.
NPK fertilization levels.
Gross rainfall.
Total tons sucrose.
Sucrose % cane.

The punching of the data sheets and computer analysis of the data was carried out by the Biometry Department of the Experiment Station. The programmes used to do this work are part of the standard EXSTAT data processing system developed by the Experiment Station.

Results

(a) *On farm records :*

A typical printout is shown in Appendix 3 for a grower who gave only the essential data for the past two seasons. His yields are expressed by ratoon, variety, soil type, seasonal or mature cane, and age at harvest. The original data that he supplied was also trapped for him (Appendix 4); together with additional derived data, such as tons cane per hectare, on an individual field basis. In addition to this, he also received a set of two way tables which assist in identifying problem areas more specifically (Appendix 5).

Another individual farm result is illustrated in greater detail in Tables 1-3. In this instance some action could be recommended.

It can be seen from Table 1 that the grower's preference for the older varieties, NCo 310 and N53/216, had reduced his yield potential by 8,3%. Further his farm average age of cane at the time of cutting was 18,5 months, which is 2 months higher than the average for his homogeneous area. Attention to the nearly 0,3 of his cane cut at ages greater than 22 months could improve his yields by a further 8,7%

TABLE 1

Yield data by variety (1973/74-1978/79)

Variety	Total ha cut	Tons cane/ha/month
NCo376	470	4,81
NCo310	487	3,72
N55/805	223	4,91
CB36/14	85	6,10
N53/216	103	3,70
N7	10	3,85
NCo382	37	3,50
NCo293	51	2,52
N50/211	5	5,00
Mixed	45	4,87
Total/Average	1 516	4,52

(Table 2). Thus by reducing the area under NCo 310 and N53/216, and reducing the cutting age to the area average, production could be increased by 17%.

TABLE 2
Yield data by age harvested (1973/74-1978/79)

Age at harvest (months)	Total ha cut	Tons cane/ha/month
10	5	6,37
11	41	5,15
12	53	6,18
13	87	5,66
14	42	5,79
15	100	5,48
16	60	4,95
17	106	4,62
18	108	5,02
19	144	4,17
20	123	4,92
21	84	4,56
22	116	4,17
23	77	3,71
24	142	3,34
25	—	—
26	—	—
27	20	3,92
28	41	3,31
29	15	3,60
29+	152	—
Mean 18,5	1,516	4,52

TABLE 3
Yield data by soil type (1973/74-1978/79)

Soil type (Parent material)	Total ha cut	Tons cane/ha/month
Middle Ecca	589	4,46
Alluvium	107	4,71
TMS	526	4,23
Dwyka	210	4,03
Dolerite	84	3,83
Total/Average	1 516	4,52

TABLE 4
Varieties x age interaction

Age at harvest (months)	Variety					
	NCo376		N55/805		CB36/14	
	Ha harvested	tc/h/m	Ha harvested	tc/h/m	Ha harvested	tc/h/m
10	–	–	5	6,4	–	–
11	5	6,9	–	–	20	5,8
12	9	6,3	10	7,0	24	7,2
13	12	6,4	23	5,5	14	6,7
14	5	5,1	25	5,7	5	7,4
15	82	5,7	–	–	9	4,7
16	11	5,9	27	4,6	–	–
17	47	5,1	8	6,1	–	–
18	43	5,0	27	5,6	–	–
19	36	4,5	19	4,8	–	–
20	53	4,7	15	5,4	8	5,3
21	34	4,6	15	4,7	–	–
22	47	4,9	–	–	–	–
23	4	4,1	32	4,0	–	–
24	13	3,5	2	3,9	5	4,7
25	–	–	–	–	–	–
26	–	–	–	–	–	–
27	2	3,3	–	–	–	–
28	17	2,8	–	–	–	–
29	–	–	–	–	–	–

TABLE 5
Varieties x soil interaction

Variety	Soil type			
	Middle Ecca		Dolerite	
	Ha harvested	tc/h/m	Ha harvested	tc/h/m
NCo376	267	4,9	—	—
NCo310	66	3,3	46	4,6
NCo805	5	4,7	—	—
CB36/14	81	6,3	—	—
N53/216	88	3,6	14	3,4
N7	10	3,9	—	—
NCo293	28	2,3	24	2,8
N50/211	5	5,0	—	—
Mixed	38	5,0	—	—

It can be seen from Table 1 that the variety CB36/14 is doing exceptionally well, and from Table 3 that normally fertile soils derived from dolerite are giving anomalously poor results. An examination of some interactions in Tables 4 and 5 may help explain the observed phenomena.

From Table 4 it can be seen that CB36/14 enjoyed the considerable advantage of having been cut generally at a young age, and from Table 5 it can be seen that dolerite-derived soils suffered the disadvantage of being planted with the most unsuitable varieties.

Not all analyses of farm records have provided options as clearcut as those illustrated above. In many cases the average age of cane at harvest could profitably be reduced, varieties on different soil types changed, and attention paid to the ratoonability of cane. In many cases, too little attention has been paid to the productivity of successive ratoons when deciding to plough out. Growers often do not convert their yields to tons cane per hectare per month, or take full account of the seasons in which the particular crop has grown, for example two winters and one summer, or vice versa.

The analysis of their farm records has shown some growers that their farms are being well managed, and this independent appraisal has naturally led to some satisfaction being felt.

(b) *Between farm (area) analysis:*

The data available for analysis from the 37 farms are listed in Table 6 :

TABLE 6
Breakdown of full area analysis by season

Season	No. of fields	Total ha	Mean age (m'ths)	Total tons cane	tc/h	tc/h/m
1975/76	178	674	18,9	58 038	86	4,55
1976/77	351	1 389	18,2	132 630	96	5,24
1977/78	762	3 323	17,9	321 399	96	5,40
1978/79	935	4 234	17,3	403 365	95	5,51
1979/80	75	294	18,5	31 312	107	5,75
Total/ mean	2 302	9 934	17,8	948 529	96	5,37

As can be seen, most growers supplied data for two seasons, and a few were able to go even further back in their records. Analyses of the data by ratoon, variety, soil type and age at the time of harvest are shown in Figures 1, 2, 3 and 4 respectively.

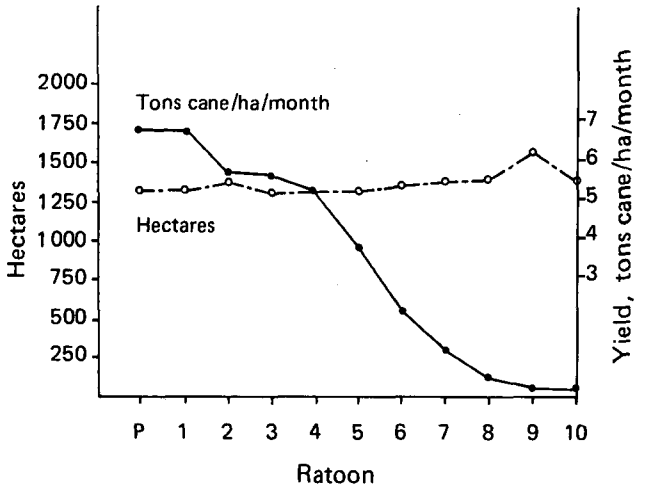
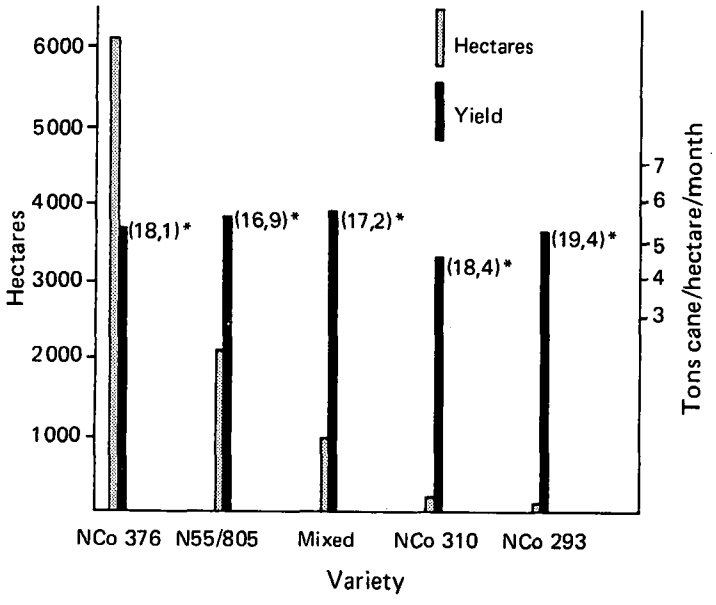
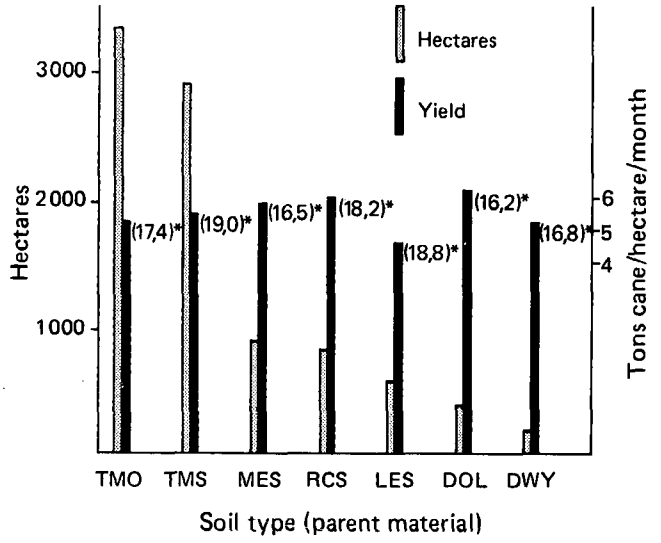


FIGURE 1 Yields in relation to crop stage.



* Age at harvest in months

FIGURE 2 Average yields of varieties and the area occupied by each variety.



* Average age at harvest in months

FIGURE 3 Average yields being obtained on different soil types and the area of each soil type represented.

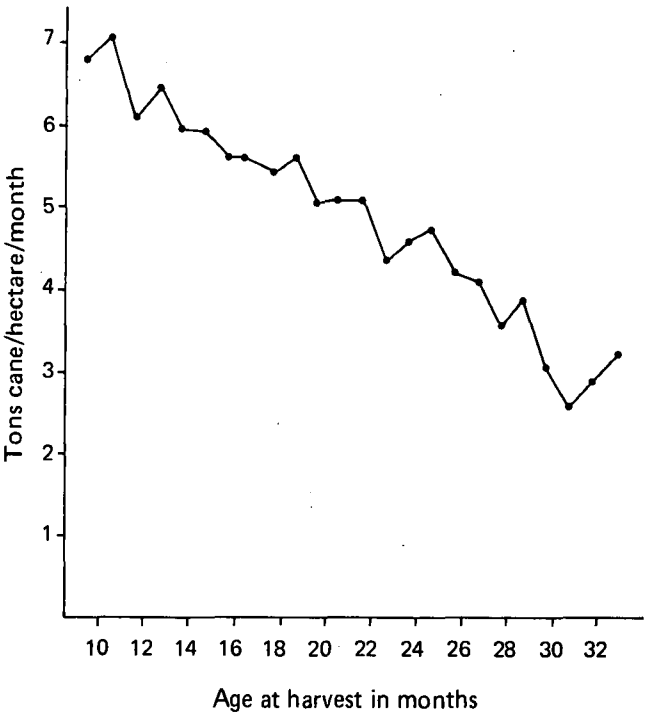


FIGURE 4 Average yields in relation to age at time of harvest.

Only the best fields are likely to survive as old ratoons and a sharp decline in average yields of succeeding ratoons would therefore not be expected. Nevertheless, the complete absence of any decline, as shown in Figure 1, leads to the suspicion that growers may be overzealous in ploughing out cane, and that in general longer ratooning may be economically warranted.

Figure 2 indicates that N55/805, somewhat surprisingly, outyields NCo376. A correction for age of harvest would reverse this order, but such a correction would not alter the fact that N55/805, as used by growers, outyields NCo376.

In Figure 3 it can be seen that much of the extension area consists of soils derived from Table Mountain Sandstone and under local conditions it is apparent that yields do not differ much from one to another.

Figure 4 shows that there is a linear decline in yield, with increasing age of the crop, bearing out the Experiment Station contention that productivity per unit of time is greater when crops are harvested as young as possible.

Tables were constructed to illustrate the variety x crop, variety x soil type and variety x age interactions. From this type of table, for example, it can be seen that 50% less N55/805 has been planted during the last two years compared with the previous two years.

The extension area has been divided into four main homogeneous areas in order to make comparisons between farms more realistic. The 1978/79 season was chosen as the base season and the main statistics are shown in Table 7.

TABLE 7

Production figures of homogeneous areas for the 1978/79 season

Area	Ha	Mean age (months)	tc/h	tc/h/m
Coastal	474	16,8	110	6,54
Coastal hinterland .	1 602	16,7	84	5,02
Rising plateau . .	1 410	16,9	92	5,47
Upper plateau . .	836	19,0	111	5,89

The coastal belt consists mostly of coastal sands and generally has a high rainfall. The coastal hinterland consists of heavier soils derived from Ecca shales, dwykas and dolerite and a few farms fall within a rainshadow. The rising plateau consists mainly of ordinary Table Mountain Sandstone soils while the upper plateau has the same parent material, but comprises mistbelt soils. The influences of climate on average yields can clearly be seen.

Table 8 shows the yield of each variety in each homogeneous area.

TABLE 8

Yield in tc/h/m of each variety in four homogeneous areas

Area	NCo376	N55/805	Mixed	NCo310
Coastal . .	7,08 (17,8)*	6,10 (16,9)	7,06 (14,9)	6,42 (16,3)
Coastal hinterland .	4,84 (17,1)	5,54 (15,4)	6,18 (15,5)	4,25 (18,8)
Rising plateau	5,49 (17,1)	5,51 (16,4)	5,31 (16,9)	— —
Upper plateau	5,91 (19,4)	5,64 (17,6)	6,21 (18,0)	— —

* Age at time of harvest in months.

It is interesting to note that NCo376 outyields N55/805 on the sands, and it is presumed that this is due to the extensive use of nematicides. However, interaction tables indicate that twice as much N55/805 is grown on the sands as is NCo376, presumably on the poorer sands.

Discussion

Every grower who has submitted data for analysis has considered that the time taken in filling in his data sheets has been a good investment, and has expressed his willingness to submit data annually. In many cases, the grower has for the first time appreciated the benefit of a realistic assessment of his farm, and it is with confidence that he now makes changes where necessary.

Growers have yet to see the data for all of the farms and for the homogeneous areas, and it is anticipated that the many advantages which they provide will be appreciated.

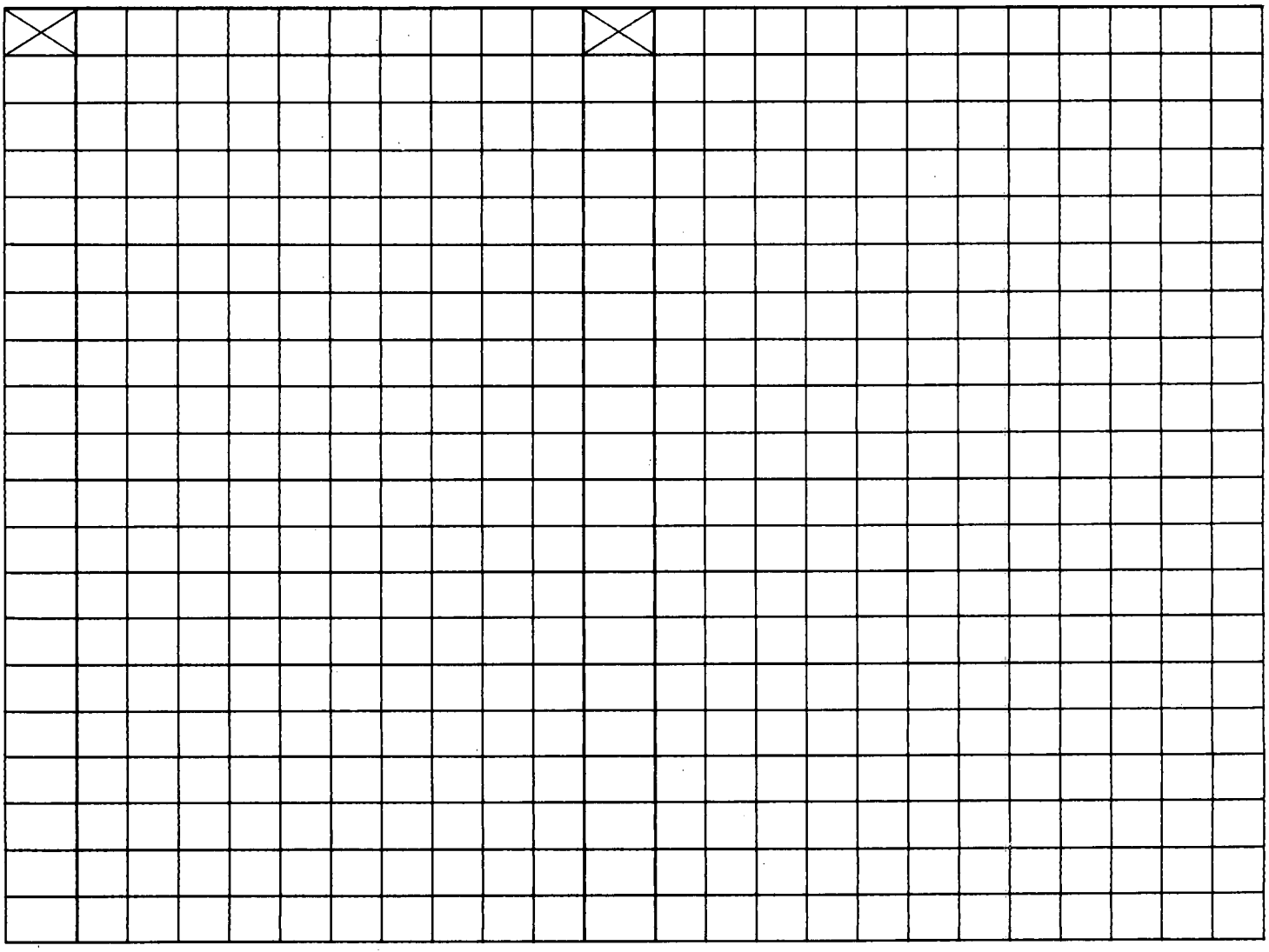
As additional data are accumulated annually, the accuracy of the results will improve progressively. If this system of farm record analysis were to be introduced in other extension areas, even more useful comparisons could then be made.

Acknowledgements

The authors wish to thank all those growers who submitted data, without which this paper would not have been possible.

Appendix 1

SASA EXPERIMENT STATION FIELD ANALYSIS DATA SHEET



Appendix 2

SASA EXPERIMENT STATION				FIELD ANALYSIS							DATA SHEET		NAME:								OFFICE USE	
																				AREA CODE:		
																				SEASON:		
1 2 3 4 5 6 7 8 9	10 11	12 13 14 15	16 17	18 19	20 21	22 23	24 25	26 27	28 29	30+	F5.1	F5.1	F5.0	F5.1	F5.0	F5.0	F5.0	F5.0				
FIELD NAME OR NUMBER	Ratoon	Variety	Soil	Mature Seasonal	Trash vs Burn					Area harv.	Age	Tons cane	Tons suc.	Fertilizer (kg/ha) N	P	K	Rain (mm)	Irrig. (mm)				

Appendix 3

S.A.S.A. EXPERIMENT STATION EXTENSION SERVICE

XXXXXXX ESTATES 1977/78 TO 78/79

	CODE	NO. OF FIELDS	TOTAL HECTAR	MEAN AGE	TOTAL T.CANE	T.CANE /HA.	T.CANE /HA.MT
CROP							
"PLANT	" 1	21.	57.6	16.6	6792.	117.9	7.10
"1ST RATOON	" 2	21.	51.5	16.6	5257.	102.1	6.15
"2ND RATOON	" 3	20.	47.0	16.3	5197.	110.6	6.79
"3RD RATOON	" 4	17.	32.4	14.9	3531.	109.0	7.33
"4TH RATOON	" 5	11.	30.0	16.1	3344.	111.5	6.72
"5TH RATOON	" 6	3.	11.0	14.7	1322.	120.2	8.16
"6TH RATOON	" 7	1.	1.9	17.0	252.	132.6	7.80
"GRD.MEAN	" 15	94.	231.4	16.1	25695.	111.0	6.88
VARIETIES							
"NCO 376	" 1	11.	17.7	15.1	2082.	117.6	7.79
"NCO 310	" 2	12.	21.6	16.1	2223.	102.9	6.40
"NCO 382	" 4	6.	19.0	17.1	2347.	123.5	7.24
"N55/805	" 5	41.	96.7	16.1	10034.	103.8	6.45
"MIXED	" 10	24.	76.4	16.2	9009.	117.9	7.27
"GRD.MEAN	" 10	94.	231.4	16.1	25695.	111.0	6.88
SOIL TYPE							
"MIDDLE ECCA	" 6	58.	128.7	15.7	13535.	105.2	6.72
"RECENT SAND	" 8	35.	100.1	16.7	11205.	111.9	6.69
"GRD.MEAN	" 9	94.	231.4	16.1	25695.	111.0	6.88
HARVEST							
"MATURE	" 1	41.	100.4	17.8	12705.	126.5	7.09
"SEASONAL	" 2	53.	131.0	14.8	12990.	99.2	6.69
"GRD.MEAN	" 3	94.	231.4	16.1	25695.	111.0	6.88
AGE							
"11 MONTHS	" 2	1.	0.8	11.0	170.	212.5	19.32
"12 MONTHS	" 3	3.	6.1	12.0	549.	90.0	7.50
"13 MONTHS	" 4	5.	7.5	13.2	918.	122.4	9.27
"14 MONTHS	" 5	16.	48.3	14.2	4673.	96.7	6.79
"15 MONTHS	" 6	16.	34.1	15.2	3293.	96.6	6.36
"16 MONTHS	" 7	14.	37.4	16.0	3815.	102.0	6.38
"17 MONTHS	" 8	17.	42.6	17.0	5741.	134.8	7.93
"18 MONTHS	" 9	13.	29.0	18.0	3304.	113.9	6.33
"19 MONTHS	" 10	6.	17.6	19.0	2442.	138.8	7.30
"20 MONTHS	" 11	1.	4.0	20.0	418.	104.5	5.22
"22 MONTHS	" 13	2.	4.0	22.0	372.	93.0	4.23
"GRD.MEAN	" 29	94.	231.4	16.1	25695.	111.0	6.88

Appendix 4

S.A.S.A. EXPERIMENT STATION EXTENSION SERVICE

XXXXXXX ESTATES 1977/78 TO 78/79

FIELD NAME	RAT	VAR	SOIL	HAR	AGE	YR.	SIZE HA.	TONS CANE	T.CANE /HA.	T.CANE /HA.MT
P7	2	805	14	1	17	77	1.9	220.	115.8	6.81
P8	2	805	14	1	17	77	2.0	293.	146.5	8.62
P9	2	805	14	1	17	77	1.1	143.	130.0	7.65
P10	2	805	14	1	16	77	0.8	69.	86.3	5.39
U399	6	805	14	1	17	77	1.9	252.	132.6	7.80
U396	2	805	14	1	17	77	2.6	316.	121.5	7.15
U396	2	805	14	1	18	77	3.0	384.	128.0	7.11
U8	4	999	21	1	18	77	1.5	120.	80.0	4.44
U9	2	382	21	1	18	77	3.0	465.	155.0	8.61
S26	0	999	21	1	19	77	1.2	372.	310.0	16.32
S5	0	999	21	1	19	77	6.1	817.	133.9	7.05
U3	1	999	21	1	18	77	3.2	429.	134.1	7.45
U4	2	999	14	1	18	77	3.1	329.	106.1	5.90
P2	2	805	14	1	19	77	1.8	205.	113.9	5.99
U2	1	999	21	1	19	77	4.4	536.	121.8	6.41
F1	4	376	14	1	17	77	1.7	148.	87.1	5.12
R102	4	382	21	1	17	77	4.0	528.	132.0	7.76
S65	2	310	21	1	17	77	1.5	175.	116.7	6.86
B7	0	805	21	1	18	77	3.2	335.	104.7	5.82
B9	0	805	21	1	18	77	0.8	165.	206.3	11.46
B8	0	805	21	1	18	77	1.6	148.	92.5	5.14
M2	0	805	21	1	17	77	4.0	333.	83.3	4.90
P5	0	310	14	1	18	77	0.9	80.	88.9	4.94
P6	0	310	14	1	18	77	1.9	234.	123.2	6.84
B2	1	999	21	2	16	77	2.4	240.	100.0	6.25
B4	1	999	21	2	16	77	4.5	434.	96.4	6.03
B3	1	999	21	2	16	77	5.2	470.	90.4	5.65
B6	1	999	21	2	16	77	0.6	143.	238.3	14.90
M3	3	805	14	2	15	77	4.0	408.	102.0	6.80
B11	0	999	21	2	16	77	3.5	317.	90.6	5.66
U5	2	805	14	2	16	77	3.3	272.	82.4	5.15
U6	2	805	14	2	16	77	2.7	162.	60.0	3.75
U34	1	805	14	2	15	77	2.5	294.	117.6	7.84
U19	1	805	14	2	15	77	1.2	96.	80.0	5.33
U30	3	376	14	2	16	77	0.2	215.	1075.0	67.19
U36/37	4	805	14	2	16	77	5.3	470.	88.7	5.54
B8/9	4	805	21	2	11	77	0.8	170.	212.5	19.32
B10	4	376	21	2	16	77	2.3	243.	105.7	6.60
U29	1	376	14	2	14	77	1.5	261.	174.0	12.43
U23	1	805	14	2	15	77	2.8	318.	113.6	7.57
F2	1	805	21	2	15	77	0.6	293.	488.3	32.56
U21	4	310	14	2	15	77	2.8	190.	67.9	4.52
M1	0	999	21	2	14	77	7.5	578.	77.1	5.50
S64	1	310	14	2	15	77	0.4	40.	100.0	6.45
U35	1	805	14	2	15	77	4.7	30.	6.4	0.41
P1	1	805	14	2	15	77	3.2	275.	85.9	5.54
U11	0	999	14	2	14	77	3.3	277.	83.9	5.79
U17	2	805	14	2	15	77	3.0	389.	129.7	8.37
U18	3	805	14	2	15	77	0.8	103.	128.8	8.31
U38	1	999	21	2	15	77	1.1	90.	81.8	5.28
U13	2	310	14	2	13	77	1.2	144.	120.0	8.89
U12	2	310	14	2	13	77	1.1	125.	113.6	8.42
U24	3	376	14	2	13	77	0.8	77.	96.3	7.13
S4A	1	382	21	1	22	78	2.6	236.	90.8	4.13

Appendix 5

XXXXXXX ESTATES 1977/78 TO 78/79

VARIETIES X CROP TABLE T.C.H. (WEIGHTED MEANS)

	NCO 376		NCO 310		NCO 382		N55/805		MIXED		MEANS	
PLANT	3	7.15	3	6.31	0	0.0	6	5.58	9	8.04	21	7.10
1ST RATOON	1	12.43	2	5.07	2	4.23	8	5.69	8	6.63	21	6.15
2ND RATOON	1	7.02	4	6.97	1	8.61	11	6.56	3	6.60	20	6.79
3RD RATOON	4	9.53	1	12.06	0	0.0	10	6.66	2	6.41	17	7.33
4TH RATOON	2	5.95	2	3.26	1	7.76	4	7.86	2	7.82	11	6.92
5TH RATOON	0	0.0	0	0.0	2	3.61	1	7.08	0	0.0	3	8.16
6TH RATOON	0	0.0	0	0.0	0	0.0	1	7.80	0	0.0	1	7.80
GRD.MEAN	11	7.79	12	6.40	6	7.24	41	6.45	24	7.27	94	6.88

VARIETIES X CROP TABLE TOTAL HECTAR

	NCO 376		NCO 310		NCO 382		N55/805		MIXED		MEANS	
PLANT	3	5.70	3	4.50	0	0.0	6	15.60	9	31.80	21	57.60
1ST RATOON	1	1.50	2	3.90	2	4.00	8	19.10	8	23.00	21	51.50
2ND RATOON	1	2.80	4	6.40	1	3.00	11	24.00	3	10.80	20	47.00
3RD RATOON	4	3.70	1	2.50	0	0.0	10	20.00	2	6.20	17	32.40
4TH RATOON	2	4.00	2	4.30	1	4.00	4	13.10	2	4.60	11	30.00
5TH RATOON	0	0.0	0	0.0	2	8.00	1	3.00	0	0.0	3	11.00
6TH RATOON	0	0.0	0	0.0	0	0.0	1	1.90	0	0.0	1	1.90
GRD.MEAN	11	17.70	12	21.60	6	19.00	41	96.70	24	76.40	94	231.40

VARIETIES X SOIL TYPE TABLE T.C.H. (WEIGHTED MEANS)

	NCO 376		NCO 310		NCO 382		N55/805		MIXED		MEANS	
MIDDLE ECCA	9	8.27	11	6.36	0	0.0	31	6.40	7	7.31	58	6.72
RECENT SAND	2	6.40	1	6.86	6	7.24	10	6.58	16	6.54	35	6.69
GRD.MEAN	11	7.79	12	6.40	6	7.24	41	6.45	24	7.27	94	6.88

VARIETIES X SOIL TYPE TABLE TOTAL HECTAR

	NCO 376		NCO 310		NCO 382		N55/805		MIXED		MEANS	
MIDDLE ECCA	9	13.60	11	20.10	0	0.0	31	75.60	7	19.40	58	128.70
RECENT SAND	2	4.10	1	1.50	6	19.00	10	21.10	16	54.40	35	100.10
GRD.MEAN	11	17.70	12	21.60	6	19.00	41	96.70	24	76.40	94	231.40