BUREAU OF SUGAR EXPERIMENT STATIONS
QUEENSLAND, AUSTRALIA

FINAL REPORT
SRDC PROJECT BS7S
IMPROVING THE YIELDS OF RATOON CROPS OF SUGARCANE

by

L S Chapman, BSES, Mackay
R Ferraris, CSIRO, Brisbane
M M Ludlow, CSIRO, Brisbane
A P Hurney, BSES, Mackay

SD92001

This Project was funded by the Sugar Research Council/Sugar Research and Development Corporation during the 1988/89, 1989/90 and 1990/91 financial years.

BSES Publication
SRDC Final Report SD92001 **July 1992**

CONTENTS

CONTENTS

1. INTRODUCTION

The economics of sugarcane growing improve with the number of ratoon crops which can be grown from a single planting. In Australia, declining yields with increase in the number of ratoons limit a cycle to three to five ratoons, according to district. However, studies by BSES indicate that the most economic strategies involved growing up to six ratoons. If this decline in yield could be reduced, then more ratoons could be obtained from a single planting with the associated economic benefits.

Ratooning is a response to a number of factors including plant, environment and management. The main plant characteristics which influence the ability to ratoon are the capacity to produce tillers, and tiller and stool survival. Modifying the influence of plant factors are climatic and soil factors such as moisture and soil aeration, which in turn may be modified by cultural operations such as timing of harvest, nutrition and traffic. Because ratooning is a complex process, there is a need to consider the various factors likely to influence the process. A workshop on the problem recommended:

- ratooning ability should be evaluated where some environmental limitations are operating
- study of basic mechanisms of ratooning should have priority
- experimentation should involve a comparison of yield and components over a range of environments
- consideration of varietal variation in yield components between crop classes, stool rejuvenation and pest and disease dynamics.

The cane selection program has produced some good ratooning varieties, but the assessment of ratooning performance takes a protracted period. Research into mechanisms of ratooning could be of value to breeders by providing criteria for selection of genotypes with good ratooning ability at an early stage of the cane improvement program.

Economic analysis (BSES, unpublished data), of a long-term ratooning study, involving four cultivars in the Mackay area, indicated that on a 60 ha farm basis and using results of the best ratooning cultivar, the discounted cash flows for various cropping cycles increased with number of ratoons, as shown below -

Plant crop + 2 ratoons	\$5 150
Plant crop + 3 ratoons	\$5 260
Plant crop + 4 ratoons	\$5 870
Plant crop + 5 ratoons	\$5 900
Plant crop + 6 ratoons	\$5 760

In a survey of 22 farms in the Proserpine area (BSES, unpublished data), the ratooning process averaged 4 man hours/ha while the planting process averaged 36 man hours/ha.

The planting process has been costed at about $1 100/ha (M Wegener, pers. comm.) and comprised a major input. Amortisation of this cost over a longer period benefits profitability.

These data indicate the savings possible to the industry and growers if the cropping cycle can be extended by minimising the decline in yield in ratoon crops.

2. OBJECTIVES

- identify the physiological and morphological characteristics of good ratooning varieties
- develop techniques for screening varieties for these attributes.

3. METHODS AND MATERIALS

Replicated variety trials were conducted with six to nine varieties which were known to have poor to good ratooning ability from previous research. At Mackay, trials were conducted with normal cultivation under rainfed and irrigated conditions (Chapman *et al*, 1992; Ferraris *et al*, 1992; Ferraris *et al*, 1993). At Tully, trials were conducted with normal cultivation and a green trash mulch (Hurney, 1992). Thus any interaction between environment and ratooning ability could be evaluated.

Data collection included photosynthetic rate and effect of red:far-red light on tillering (Ludlow *et al*, 1990), leaf nitrogen and water stress (Ludlow *et al*, 1991; Hurney, 1992), temperature and water supply (Ferraris *et al*, 1992), bud development (Ferraris and Chapman, 1991a, b; Hurney, 1992) canopy development, stalk population and cane yield (Chapman *et al*, 1992; Ferraris *et al*, 1992; Ferraris *et al*, in press; Hurney, 1992).

Historical data from BSES plant breeding was statistically evaluated (Kerr, unpublished). Yield of commercial cane was used to evaluate confounding of genotype x year and genotype x crop (Ferraris *et al*, in preparation).

4. RESULTS AND DISCUSSION

Results indicated there were differences in yield potential of varieties in plant crops. In successive ratoon crops yield declined and was different for varieties. Higher ratoon yields were therefore attributed to both high yield potential and ratooning ability. Differences in ratooning ability were expressed under rainfed and irrigated conditions, but not under harsher conditions. Thus a genotype by environment interaction for ratooning ability is indicated (Chapman *et al*, 1992). There were differences in yield of varieties between the conventional and trash conservation systems, but the relative ranking of ratooning ability was similar (Hurney, 1992).

The decline in cane yield with subsequent ratoons was associated mostly with a decrease in stem weight rather than in stem number (Chapman *et al*, 1992; Hurney, 1992).

Light interception, particularly during the early growth to full canopy, was identified as the primary plant determinant of yield of ratoon crops (Ferraris *et al*, 1992; Ferraris *et al*, 1993). Ratooning ability of varieties was associated with the efficiency with which the light was utilised, particularly after full canopy was developed, which is more than half the growing period (Ferraris *et al*, 1992).

Varieties with higher yield of ratoon cane showed rapid canopy development and so intercepted more light. However, there were exceptions (Hurney, 1992). High early tiller density and high rate of leaf appearance were important to rapid canopy development. Canopy development by varieties was possibly associated with the ability to extract soil water and with water use in early growth (Ferraris *et al*, in press). The old root system from harvested cane appeared to remove subsoil moisture and actively support the young ratoon growth (Hurney, 1992).

The hypotheses that good ratooning was associated with high leaf photosynthetic rates, or high red:far-red ratio at the base of shoots was proved negative (Ludlow *et al*, 1990).

There appears no direct relationship between ratooning ability and photosynthetic response to water potential and specific leaf nitrogen, except that poor ratooners showed no response to either variable (Ludlow *et al*, 1991).

A glasshouse study of the dynamics of bud development in ratooning stubble indicated that in the early ratoons, development was adequate for ratoon growth (Ferraris and Chapman, 1991a). The number of buds per stem piece decreased with older ratoons, thus damage of buds at harvest could affect ratooning ability (Hurney, 1992).

The rate of bud emergence from stubble pieces was enhanced by wetter rather than drier soil conditions (Ferraris and Chapman, 1991b). Trash conservation reduced bud development (Hurney, 1992).

An examination of archival data, collected within the current plant breeding program, found no predictor which was consistently better than assuming the variety differences in plant and early ratoons will persist in later ratoons (Kerr, unpublished).

The first objective of this project has been achieved.

5. DIFFICULTIES ENCOUNTERED

A major difficulty was that old ratoons take time to establish and it was not possible to obtain old ratoons within a three-year project period. Therefore, most of the data was collected from younger ratoons. This difficulty was overcome to some extent by planting the trials at Mackay one year before funding was available, and by completing the harvest of the third ratoon crops after funding had finished.

6. RECOMMENDATIONS FOR FURTHER RESEARCH

The second objective to develop and to implement screening methods for identifying 'good ratooning varieties' has not been achieved. It appears that early canopy development is a factor associated with good ratooning varieties, but it would be necessary to evaluate this over a wider spread of genotypes before it can be accepted.

Data collected in this project are suitable for modelling ratoon growth. A model would establish the relationship between the attributes measured during ratooning and cane yield.

The reason for the decline in yield of successive ratoons, and in particular the decline in stalk weight, has not been determined. Research into the biochemistry of ratooning and the decomposition of stubble and roots may identify chemicals toxic to growth.

7. LIST OF PUBLICATIONS ARISING FROM THE PROJECT

Chapman, L S, Ferraris, R and Ludlow, M M (1992). Ratooning ability of cane varieties. 1. Variation in yield and yield components. Proc. Aust. Soc. Sugar Cane Technol. 1992 Conf., pp 130-138.

Ferraris, R and Chapman, L S (1991a). The dynamics of bud development in ratooning stubble of sugarcane varieties. Proc. Aust. Soc. Sugar Cane Technol. 1991 Conf., pp 164-171.

Ferraris, R and Chapman, L S (1991b). Effect of moisture regime on early development of ratoon buds. Proc. Aust. Soc. Sugar Cane Technol. 1991 Conf., pp 172-178.

Ferraris, R, Chapman, L S and Ludlow, M M (1993). Ratooning ability of cane varieties: ~~2. Determinants of yield~~ interception of light + efficiency of light use. Proc. Aust. Soc. Sugar Cane Technol. 1993 Conf., ~~(accepted)~~ pp316-322

Ferraris, R, Chapman, L S and Ludlow, M M (1992). Responses of canopy growth of sugarcane to temperature and water supply. Proc. Int. Soc. Sugar Cane Technol. 22: ~~(in press)~~.

Ferraris, R, Chapman, L S and Ludlow, M M (199?). Crop development and ratoon yield of sugarcane varieties. Field Crops Research (submitted).

Ludlow, M M, Ferraris, R and Chapman, L S (1990). Variation in net photosynthetic rates of sugarcane leaves and differences in the ratio of red:far-red light beneath the canopy among varieties with different ratooning capacities. Proc. Aust. Soc. Sugar Cane Technol. 1990 Conf., pp 105-110.

Ludlow, M M, Ferraris, R and Chapman, L S (1991). Interaction between nitrogen and water supply on the photosynthetic rate of sugar cane leaves. Proc. Aust. Soc. Sugar Cane Technol. 1991 Conf., pp 66-72.

Kerr, J D (unpublished). Prediction of sugar yield for ratoon crops. Biometrics unit report. CSIRO Institute of Plant Production and Processing.

Hurney, A P (1992). Improving the yields of ratoon crops of sugarcane - Tully Studies. BSES Internal Report.

Ferraris, R, Jones, P N and Chapman, L S. Use of covariance to minimise confounding of genotype x year and genotype x crop effects in sugarcane. (In preparation).

ATTACHMENT 9

June 1989

PREDICTION OF SUGAR YIELDS FOR RATOON CROPS

J. D. KERR

CSIRO Biometrics Unit, Cunningham Laboratory, St Lucia, Qld 4067

Consulting Report No. BU 89/1

Prepared for BSES.

Summary

This report considers data from BSES variety trials from north Queensland. The analyses are directed at finding predictors of the later ratoon crop yields from the earlier ratoon and plant crops. The conclusion is somewhat negative, however positive recommendations are made for future studies.

Please note:

(i) If these results are to be used in any publication, you are requested to show it to the author of this report before submission, whether the above author is a joint author of that publication or just acknowledged within it.

(ii) Copies of this report will be released only with the client's permission.

PREDICTION OF SUGAR YIELDS FOR RATOON CROPS

Summary

I have found no one characteristic which consistently predicts the yield of a ratoon crop. A particular site may suggest there is, but it does not hold across sites. Where there is a large range in the performance of the varieties, a simple extrapolation of the trend in sugar or cane production eliminated about half the between varietal variation. The results suggest that poorly performing varieties may be quickly discarded but that discrimination between later ratoons of better varieties cannot be made just on the basis of these measures (stalk weight, stalk density and ccs), from the early ratoons.

Farm Introduction Data

I have not analysed this data because it did not appear it would further the aims of the study. Since the objective measurements show correlations between years which reflect variety differences, it may be expected that the subjective assessments will do likewise. The subjective assessments from these trials are just of overall condition and so do not enable any study to be made of which characteristics are more important. Nor was the subjective assessments available for more ratoons than the objective measurements so there was no advantage in that direction either.

It is quite possible that subjective assessment of a number of characters might be quite a useful way to proceed in terms of obtaining more information at reasonable cost. The major problem with the data I had to analyse was that it did not extend beyond the third ratoon. Since the performance of fourth and subsequent ratoons is of considerable importance in say judging whether a variety has ratooning comparable to NCo 310, this analysis is severely limited. At the end I make some recommendations for further work.

Analysis

In the analysis I analysed log transformed data. All the results are reported on this basis, logs being take before any averaging or calculation of trends. Because of the fairly similar ranges in the different years of growth, I did not attempt to standardize the variables when averaging the data. CCS generally was less well correlated over time, but it did not fluctuate as much. For the Northern trials, on the log scale, CCS had a standard deviation of .03, weight and density each .08 and sugar production .09 (increasing from about .075 for plant cane to about .10 for 3rd ratoon).

NORTHERN TRIALS

All the analyses in this report are in the log (base 10) scale. Taking logs converts the models Cane = Weight * Density
and Sugar = Weight * Density * CCS
into additive ones log Cane = log Weight + log Density
and log Sugar = log Weight + log Density + log CCS
and because the data are positive with few values near zero, the transformation has little effect on the correlations between the same quantity (such as Weight) measured in different years.

Correlations between years for each character measured

Simple correlations (all on the log scale) were:

Trial 71-6 Campagnolo, Mourilyan

	Production			Weight			Density			CCS		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd Ratoon
Plant	.77	.65	.66	.63	.53	.59	.89	.68	.79	.04	.23	-.07
1st R		.81	.80		.76	.75		.71	.79		.44	.54
2nd R			.87			.75			.85			.55

Trial 78-1 Deal, Green Hills

	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd Ratoon
Plant	.43	.33	.18	.83	.58	.66	.61	.63	.45	.24	.24	.43
1st R		.48	.57		.69	.63		.89	.76		.46	.59
2nd R			.71			.63			.86			.41

Trial 76-2 A.G. Mann

	Production			Weight			Density			CCS		
Plant	.68	.28	.20	.88	.76	.64	.85	.79	.73	.66	.30	.12
1st R		.54	.56	.74	.59			.96	.80		.65	.37
2nd R			.92		.62				.87			.40
Trial 72-6 Fapani, Aloomba												
Plant	.61	.45	.52	.62	.68	.51	.60	.35	.45	.32	-.03	.29
1st R		.53	.47		.52	.55		.62	.81		.37	.30
2nd R			.63			.52			.69			.40
Trial 77-3 Dockery & Co., Goldsbrough												
Plant	.40	.35	.27	.86	.85	.83	.69	.73	.70	.24	.00	.67
1st R		.67	.47		.91	.84		.87	.86		.56	.24
2nd R			.63			.89			.91			.35
Trial 79-22 Christovoiledes, Meringa												
Plant				.43	.66		.45	.83		.37	.44	
1st R					.28			.36			.27	

Variety differences

If a breeder is to select varieties for their ratooning performance, it is necessary to have data in which those differences (assuming they exist) are clearly manifest. The smaller the differences the greater the risk of discarding varieties that should be retained and vice versa. It may be that the relative performance of the ratoons depends on the conditions; in this case the way a ratoon performs under different conditions needs to be known. Analysis of the third ratoon sugar and cane yields showed F-ratios of 13.47, 3.88, 3.31, 2.28 and 7.60 for sugar differences and 20.36, 3.36, 2.34, 2.39 and 9.73 for cane differences for the trials 71-6, 78-1, 76-2, 72-6 and 77-3 respectively. Only in 71-6 and 77-3 are the differences strongly significant.

In much of what follows I have used the mean of second and third ratoons as this will reduce the random component in the yield. An analysis of variance of the difference between the mean of 2nd and 3rd ratoon yields and the mean of plant and 1st ratoon yields showed significant varietal differences in all trials except No. 79-22. (The means were taken after log transformation)

F-ratio and degrees of Freedom:		Sugar	Cane
Trial 71-6	8,16	8.40***	8.36***
Trial 78-1	7,17	6.75***	6.77***
Trial 76-2	6,7	9.52**	9.57**
Trial 79-22	7,17	2.31+	2.32+
Trial 72-6	15,19	2.24*	2.25*
Trial 77-3	8,19	4.39**	4.36**

I also looked at the trend in log stalk weight, stalk density and ccs (treated as linear over the years) and found varietal differences were generally significant:

F-ratios and degrees of Freedom		Weight	Density	CCS
71-6	8,16	2.99*	7.17***	6.34***
78-1	7,17	7.08***	4.49**	5.28**
76-2	6,7	13.87**	3.04+	2.14
72-6	15,19	1.46	3.25*	2.00
77-3	8,19	6.06***	3.38*	2.87*
79-22 (no 3rd ratoon)	7,17	2.07	4.10**	0.61

All three components show varietal differences but no one component shows consistently the most clear differences in trend.

Selecting a predictor of the mean of 2nd and 3rd ratoons

Stepwise methods (forward selection, and backward elimination with re-entry permitted) were used to predict mean of 2nd and 3rd ratoon yields. The mean of two ratoons was used because it averages the variability from two seasons. Individual plot yields were used, not variety means. The independent variables were the mean and half the difference - after log transformation - of 1st ratoon

and plant values for stalk weight, stalk density and ccs. The selected regressions for log mean sugar yield were the same for both methods:

Using individual measures as predictors

Trial		Fisher's A
71-6	Sugar = 1.04 + 0.97 Weight Mean + 1.18 Density Mean (0.22) (0.20)	58 %
78-1	Sugar = 1.03 + 0.79 Wt Mean + 1.12 Density Mean + 1.14 Dens.Diff (0.26) (0.28) (0.47)	27
76-2	Sugar = 1.89 + 0.65 Density Mean (0.16)	47
72-6	Sugar = -0.15 + 1.43 CCS Mean + 0.70 Density Mean + 1.69 Dens.Diff (0.41) (0.27) (0.52)	31
77-3	Sugar = 1.66 + 0.48 Weight Mean + 0.75 Density Mean (0.21) (0.23)	18

(Fisher's A is a measure of the percentage of variance accounted for by regression, and the figures in brackets are standard errors)

Using Production as a Predictor

Stepwise regression requires caution in selecting predictors as it enhances the risk of including variables as a result of chance variation. As a predicting equation the simplest logical predictor is usually best. In a case like this, it may be better to use past sugar production to estimate ratoon sugar production and see whether stepwise methods show that this may be improved by introducing other predictors. Thus if ccs from previous years was of no use predicting sugar yield, the stepwise regression could remove it by giving it a -1 coefficient. When the predictors were altered to Sugar (sum of Weight, Density and CCS on the log scale) plus Weight and CCS, the selected regressions were:

71-6	Sugar = -.24 + 1.11 Sugar Mean (0.17)	61
78-1	Sugar = 0.17 + 0.89 Sugar Mean + 0.86 Sugar Difference (0.27) (0.42)	24
76-2	Sugar = 0.99 + 0.69 Sugar Mean - 0.63 Weight Mean (0.22) (0.18)	40
72-6	Sugar = 0.30 + 0.85 Sugar Mean (0.19)	33
77-3	Sugar = 0.71 + 0.74 Sugar Mean (0.22)	24

Although the second method had a strong tendency to select the production mean, note that in trial 76-2 the regression was altered to remove virtually all the effect of weight and in trial 78-1 the regression gave all the weight to the 1st ratoon and practically none to plant yield. However, the first set shows that CCS was only significant in one trial.

Using individual years instead of Mean and Difference as Predictors

Using sugar production for plant and 1st ratoon as predictors the regressions were:

71-6	Sugar = -.28 + 0.12 Plant + 0.96 Ratoon (0.24) (0.22)	t = 0.51, 4.31	74
78-1	Sugar = 0.17 + 0.01 Plant + 0.88 Ratoon (0.2) (0.28)	t = 0.07, 3.09	22
76-2	Sugar = 1.37 - 0.34 Plant + 0.83 Ratoon (0.30) (0.34)	t = -1.13, 2.42	10
72-6	Sugar = 0.17 + 0.55 Plant + 0.36 Ratoon (0.30) (0.17)	t = 1.80, 2.11	29
77-3	Sugar = 0.59 + 0.03 Plant + 0.72 Ratoon (0.2) (0.20)	t = 0.18, 3.69	30

Within the sets, more weight is given to the most recent or Ratoon data, but Trial 72-6 is clearly different; otherwise one would simply use the 1st Ratoon as a predictor.

When I tried to predict Sugar and Cane for the 3rd ratoon data, I found no consistent difference between using the mean of the three previous yields or fitting a trend, but using the mean the regression coefficients were not significantly different from 1 whereas all the coefficients fitted to trend were less than one and all but one significantly less than 1 ($p \leq 0.05$). The inference from this is that year to year fluctations are more important than any consistent decline of yield with ratoon. Since it is reported as common for the first ratoon to outperform the plant cane, any attempt to predict long term ratoon behaviour from just plant, 1st and 2nd ratoons is very optimistic, and the results confirm the intuition. (The greatest difficulty in this analysis is that 4th, 5th and later ratoons are of interest for the study of long term ratooning and no data has been presented beyond the third ratoon).

SOUTHERN AND CENTRAL TRIALS

I went through similar steps in examining the relationships between the three measures of weight, density and ccs and between the four years.

Simple correlations (on the log scale) were:

	Weight			Density			CCS		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd Ratoon
Rogers									
Plant	.81	.84	.89	.84	.86	.63	.70	.72	.66
1 Ratoon		.87	.85		.91	.82		.66	.47
2 Ratoon			.90			.83			.68
Brown									
Plant	.87	.64	.30	.86	.77	.65	.64	.54	.35
1 Ratoon		.75	.39		.90	.84		.68	.34
2 Ratoon			.60			.88			.35
Crear									
Plant	.57	.56	.60	.49	.59	.56	.48	.57	.40
1 Ratoon		.87	.75		.94	.86		.86	.77
2 Ratoon			.76			.82			.78
McQuillan									
Plant	.74	.80	.62	.81	.81	.67			
1 Ratoon		.61	.85		.80	.74			
2 Ratoon			.58			.80			
McIntosh									
Plant	.78			.84			.17		

Selecting Predictors of Mean Yield for 2nd and 3rd Ratoons

As for the Northern data, I used stepwise regression - forward selection and backward elimination with re-entry permitted - to examine possible predictors of mean sugar and cane yield for the 2nd and 3rd ratoons. Again, I used sugar (or cane) production as predictors, taking the mean of plant and 1st ratoon and half the difference of 1st ratoon and plant.

The regressions selected were:

	Fisher's A
McQuillan Cane = -0.33 + 1.28 Cane Mean (0.21) - 0.33 (Weight Mean) (0.15)	55 %
Rogers Sugar = -0.33 + 1.12 Sugar Mean (0.19) (t=5.79)	47
Rogers Cane = -0.27 + 1.20 Cane Mean (0.17) (t=7.17)	58
Crear Sugar = -1.80 + 1.80 Sugar Mean (0.23) + 1.64 (Weight Difference) (0.61)	61
[or = -1.43 + 1.61 Sugar Mean alone (0.24) (t=6.63)	55]
Crear Cane = -0.61 + 1.50 Cane Mean (0.24) (t=6.26)	52
Brown Sugar = 4.76 + 1.98 Sugar Mean (0.48) + 1.65 Sugar Diff (0.65) - 5.65 CCS Mean (1.45) by forward selection; or	64
= 1.87 + 3.08 Sugar Mean (0.37) - 0.71 Weight Mean (0.28) - 5.33 CCS Mean (0.74) by backward elimination	64
Brown Cane = -2.30 + 3.23 Cane Mean (0.38) - 0.92 Weight Mean (0.27)	64

The selection gives no consistent pattern on which to judge any component more important than another; my reaction is to use just Sugar and Cane as predictors of Sugar and Cane.

Predictors of 3rd Ratoon Yield

In predicting 3rd ratoon sugar yield, I regressed Sugar on 2nd ratoon Sugar yield, 1st ratoon yield and plant yield in that order. Likewise for 3rd ratoon cane yield, I regressed Cane on 2nd ratoon Cane yield, 1st ratoon Cane yield and plant cane yield. The percentage of variance removed at each step and the regression coefficients with all three predictors included were:

	Cane %			Sugar %			Cane Coefficients			Sugar Coefficients		
	2ne	1st	Plant	2nd	1st	Plant	2nd	1st	Plant	2nd	1st	Plant
McQuillan	17	46	0				0.25	1.08	-.06			
Rogers	43	8	0	42	5	0	0.36	0.43	0.13	0.49	0.31	0.00
Crear	68	5	0	52	12	1	2.38	0.64	0.27	1.02	1.00	0.25
Brown	50	7	0	48	5	1	0.77	1.57	-.08	0.96	1.32	-.64

In no case was the plant yield information useful. However the 2nd ratoon did not consistently have a larger coefficient than the first. For use in prediction where the data being predicted is not available, a predictor based on a simple mean of the two previous years appears to perform better. (A comparison with a predictor with the 3rd ratoon having double the weight of the 2nd ratoon showed that in these sets, the equal coefficient predictor accounted slightly more of the variation and while for McQuillan data, extra weight to the 3rd ratoon gave a poorer predictor.

In assessing the amount of variance accounted for, the coefficient is still estimated from the data; the coefficients varied markedly:

	McQuillan	Rogers	Crear	Brown
Cane	1.13	0.80	2.80	1.93
Sugar		0.80	2.13	1.91

but the percentage of variance accounted for - 46 to 68 percent - was more stable. Being on the log scale, the coefficient should not vary if say all yields rose or fell by a constant proportion. The coefficients around 2 rather than around 1 indicate data where the 3rd ratoon shows greater variety differences than the first and second ratoons. I do not know whether the variation in the coefficient results from variation in the varieties used or environment. However the Rogers and Crear experiments used the same varieties except for one using NCo and the other Q58 yet the coefficients are quite different. (The Rogers data file indicates it was done in three blocks of 12 although there were 18 varieties counting 3 for Q58 used three times).

The extent to which the variation in the varieties can be predicted from previous years can be used as a measure of the extent to which it is not necessary to grow the ratoon to understand how it will perform.

The percent of variation removed by the predictor adjusted for reps was

	McQuillan	Rogers	Crear	Brown
Cane	53	51	68	56
Sugar		46	64	53

When the mean of production for the second and third ratoons was predicted by regression from the corresponding yields for plant and 1st ratoon, the percent of variation removed with only the 1st ratoon yield was

	McQuillan	Rogers	Crear	Brown
Cane	52	56	57	63
Sugar		46	55	56

Except in one case, the regression coefficient for Plant yield, when added to first ratoon yield, was positive, the t-values lying between 2.10 and -0.50, the coefficient for plant generally being about half the coefficient for 1st ratoon.

Using a predictor for the mean of the two years:

0.667 (Yield of 1st Ratoon) + 0.333 (Plant cane yield)

and subtracting this from the mean halved variation in yield although, as with predicting 3rd ratoon, varietal differences remained significant except for McQuillan Cane yield.

The data sets examined showed considerable positive correlations between cane characteristics over time, and time trends which could be used to predict values for later ratoons. However no single component was found to be consistently a better predictor. The data I examined only went as far as third ratoon.

RECOMMENDATIONS

Prediction of ratoon characteristics is an important part of variety selection. Lengthy examination of the data available found no predictor which was consistently better than assuming the variety differences in plant and early ratoons will persist in later ratoons. To get a more useful answer to such an important question obviously requires more data collected for this specific purpose. (I have not found, as suggested in Mr Les Chapman's paper, that density is a consistently good predictor of ratoon yield. This may be true at some sites or under some conditions but not at others.)

To determine whether performance in late ratoons can be predicted, it is necessary to have data that includes as many ratoons as one is interested in making predictions about. It is necessary to have data on all the characteristics that are important. Not all measurements need be precise measures; some may be subjective estimates but still be very useful. Management practices may interact with ratoon yields as may weather and climate, and it can be misleading to analyse the data when these are unknown or uncontrolled. Presumably it is important to recognize poor varieties early to contain costs, but it is also necessary to recognize the cost of rejecting a potentially useful variety prematurely. A careful planned program of experiment and data collection is needed to provide the necessary information on which to base ratoon assessment.

John Kerr
John Kerr
12.6.89