SOUTH AFRICAN SUGAR INDUSTRY AGRONOMISTS ASSOCIATION

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Technology Transfer and Information Technology

By

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Introduction

The overall purpose of extension is to promote practices which will lead to increased productivity and profitability, in harmony with the environment, of all cane producers in the South African Sugar Industry. This is done through a process of creating an awareness of a recommended practice, stimulating an interest in the practice, testing the practice and finally having the practice adopted.

Experience has shown that the difficult aspect in this process is stimulating the 'grower interest'. It has been found that if information from an extension area or from an individual farm is used, the grower interest in a specific subject can be readily obtained. The required data was, prior to the use of personal computers, difficult to access and process.

The introduction of computers to extension staff during the early 1990's saw the beginning of the collection and storage of various forms of data e.g. cane yield, cane quality and the results of soil sample analyses. Initially this was a relatively tedious process. However, with the advances in computer technology and the introduction of electronic mail, the accessing and storage of large amounts of data has became possible.

The intention of this paper is to demonstrate that the computer and available data has become a useful 'extension tool' which can be used to stimulate grower interest in specific aspects of cane husbandry. The computer can also be used by the extension officer to identify factors limiting cane production and to develop appropriate extension strategies to overcome these limitations.

Information available and possible applications

Industrial data

In order to assist growers to interpret their weekly consignment cane analysis data or to explain to them what appear to be anomalies, it is essential to have 'bench mark' values for the various cane components. Presented in Figure 1 is the long term mean fibre % cane for the Eston mill and the fibre value for the 1998 season. For a full understanding, measurements for sucrose, purity, Brix, non-sucrose and moisture are also required.

Initially this data was recorded manually each week, but is now available via electronic mail.

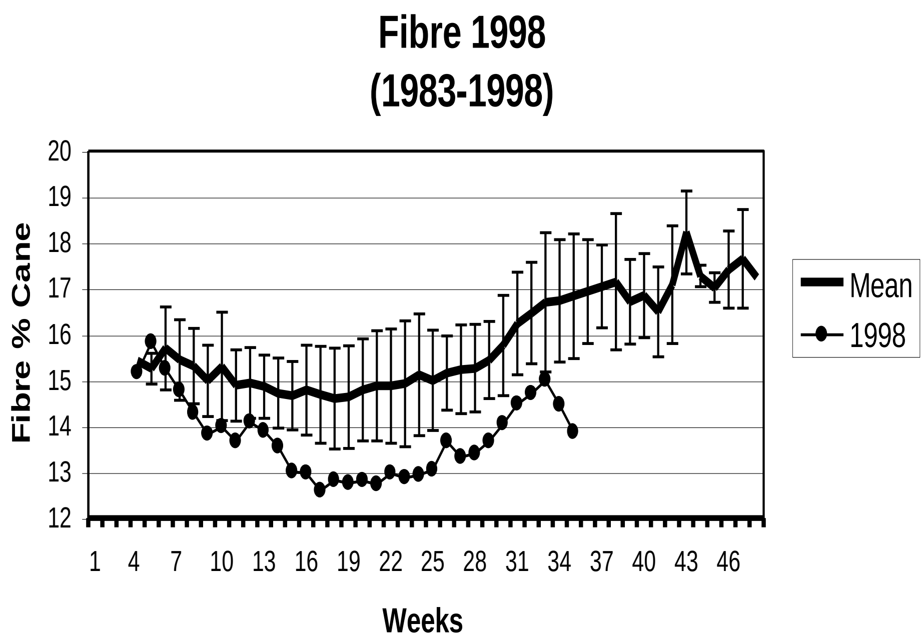

Figure 1 Mean Fibre % cane for the Eston mill (± one standard deviation) and the fibre value for the 1998 season.

The data indicates that the fibre content of the cane for the 1998 season is well below the expected values. The cane analysis for this season has been unique, but unfortunately the possible reasons for this falls outside the scope of this paper.

Whole Farm Data

To access this data it is necessary to obtain permission from the local Mill Group Board and this permission is granted subject to the data being treated in the strictest confidence.

This information is not available electronically at present. It is however, anticipated that this data will be available via the Internet on a weekly basis in the near future.

- *The relationship between relative sucrose % cane and R/ton of cane*

  The relative sucrose values and the R/ton of cane obtained during 1997 for each grower are presented in Figure 2.

  Relative sucrose % cane value has been choosen in preference to actual sucrose % cane due to the number of growers who have formed harvesting syndicates and the presence of a number of harvesting contractors who have pooled the daily delivery rate of their clients. This has resulted in a number of growers not delivering their allocation rateably.

  The variation in the sucrose content from 10.93 % to 14.68 % indicates the need for an extension programme to investigate the reason for this. The resultant variation in the R/ton of cane from R103 toR148 raises the question of the profitability of certain cane operations.

With the possible introduction of a cane quality payment system in the future, the gap between the two extremes will widen.

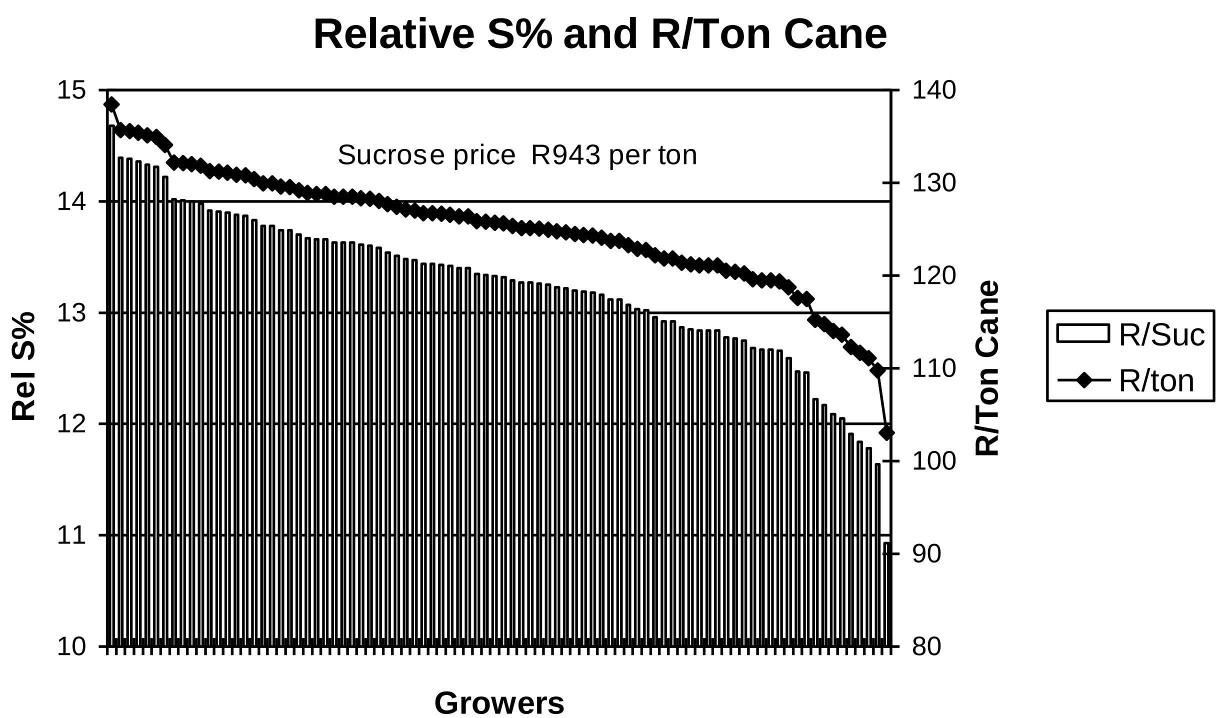

Figure 2 The relationship between relative sucrose % cane and Rand per ton of cane

- *The relationship between fibre % cane and cane purity*

The fibre and purity values recorded for each grower are presented schematically in Figure 3.

The extreme variation between the lowest fibre value of 12.83 % and the highest value of 21.32 % indicates that there is a need to educate growers on the importance of this parameter on the length of milling season.

Until such time that ash % cane becomes a routine measurement, the fibre content can assist in identifying those growers who are delivering a lot of sand to the mill. A high fibre value associated with a high purity value is a strong indication of the presence of sand in the consignment.

The fibre % cane value could be affected by the soil type of the field being harvested and also by the system of infield haulage being used. There is a need to establish whether or not there is a relationship between these factors.

The ideal combination is a high purity value associated with a low fibre % cane value.

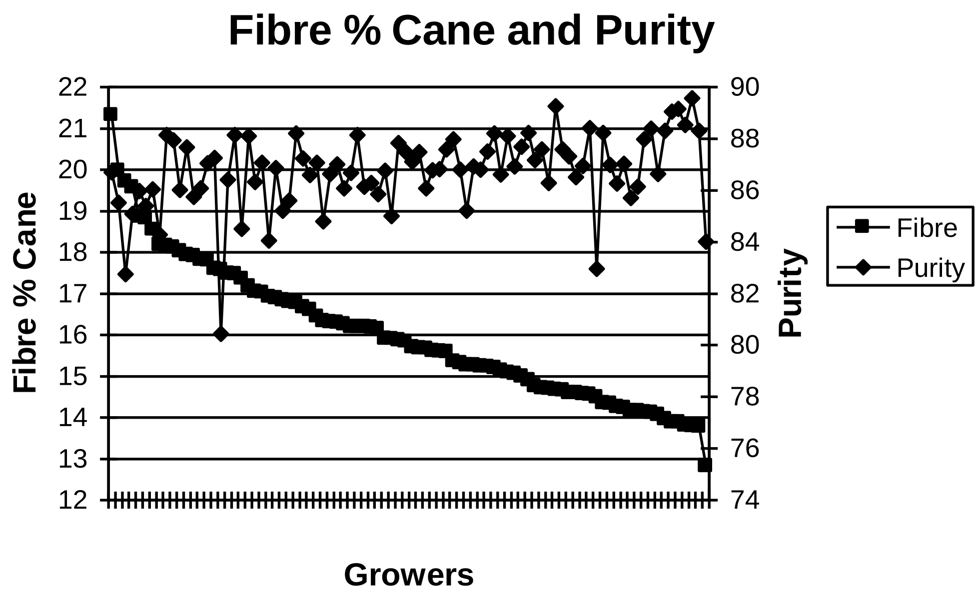

Figure 3 The relationship between fibre % cane and cane purity

- *The variation of individual grower tc/ha yield relative to the grower mean tc/ha yield*

The tc/ha yields of selected growers, expressed as a percentage of the growers mean yield, is presented in Figure 4.

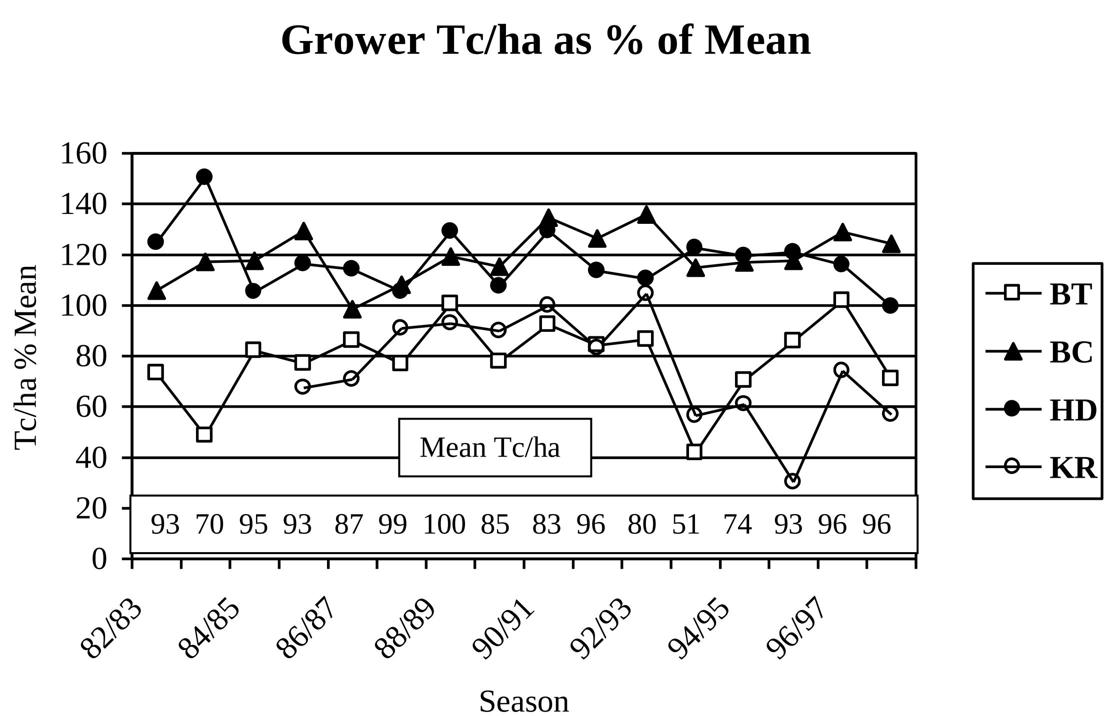

Figure 4 Grower tc/ha yield expressed as a percentage of the mean grower tc/ha yield

Farm	Rainfall	Altitude	Soil Parent Material	Clay Content
Hd	850-950	650-700	TMS(mist)+TMS(ord)	>20
Bc	800-900	700-800	TMS(ord)	15-25
Bt	700-750	700-800	TMS(ord)	<15
Hr	700-750	700-800	TMS(ord)	<15

The variety disposition has changed considerably during the 1982 to 1997 period, with Nco376 and Nco293 being the dominant varieties at the beginning and N12 currently being the dominant variety.

The initial intention when presenting the data in this format was to establish whether or not grower's production was increasing or decreasing relative to the mean yield. The actual mean tc/ha yield indicates that there is no obvious trend with time. It would appear that the rainfall distribution, particularly for a two year crop, overrides any improved practices that may have been implemented.

The more marginal farms (Bt and Kr) experienced a greater yield decline during the 1993 drought than the average grower. However, the response to the increased rainfall was greater with the marginal farms.

- *Mean Tc/ha yields for the 1982 to 1997 period and the CV%*

Table I Mean Tc/ha yields and CV% (16 years)

Mean Tcane Yields and Variation 1982/83 - 1997/98

Code	Tcane/ha	STD	CV%
MMe	106.1	26.4	24.9
MBc	103.8	17.8	17.2
MAr	101.8	10.3	10.1
PGr	99.2	9.7	9.8
MFh	91.7	22.8	24.9
ESa	90.2	25.1	27.9
EDd	88.7	21.0	23.7
EBp	72.7	14.7	20.2
GBt	69.1	20.1	29.1

The data presented in Table 1 is useful to an extension officer in that it not only highlights the yield performance of individual growers, but also indicates the level of production that can be expected from the different homogeneous areas in the extension district. The CV% also gives an indication of the effect of management or rainfall has on the yields. The relatively high CV% values for high potential farms Mme and MFh are an indication of poor management, while similar values for lower potential farms MBc, Edd and Ebp are largely the result of rainfall distribution.

The mill move to Eston and the need to advise potential new growers on the viability of planting cane has shown how valuable this type of information can be.

- *Annual record of cane yield and cane quality*

Table 2 Cane yields and cane quality for the 1997/98 season

Code	Tc/ha	Act S%	Rel s%	Trs/ha	Fibre	Purity	Moist
MMe	134.3	14.1	14.3	19.2	13.8	88.3	70.3
MBc	119.1	14.8	14.7	17.5	13.8	89.6	69.7
TWb	122.6	13.4	13.3	16.3	14.3	87.0	70.3
MAr	110.7	13.9	14.0	15.5	14.0	88.3	70.3
MDn	104.6	13.9	13.9	14.5	16.2	88.2	68.1
MHp	98.4	13.7	13.7	13.5	14.1	88.4	70.4
MHn	94.1	13.2	13.3	12.5	17.6	87.3	67.3
GBr	88.2	13.4	13.2	11.6	16.2	88.2	68.6
GSh	81.7	10.8	13.4	10.8	17.8	81.7	68.9
GSg	68.8	13.9	13.8	9.5	18.2	88.1	66.0
EMr	48.4	14.2	14.1	6.9	14.1	86.6	69.5

Unfortunately the whole farm data that is available (Table 2) does not give the average age at harvest. Although this can be estimated, it is felt that this can lead to incorrect interpretations.

It is always a surprise to see the range of yields that are obtained each season. The high purity values associated with fibre values in excess of 14% for five of the farms indicates that sand is contributing to the high fibre value. The low purity and high fibre for farm GSh indicates a sand problem and stressed cane or long delays between burning and crushing.

Care must be taken when interpreting this information. The poor performance of a farm could be the result of factors other than poor management. In order to establish the reasons for the particular performance it is necessary to have access to individual field data.

Individual Field data

When dealing with individual field data a convenient method of using these data has been to summarize the yield data and determine a mean value for each variable. Although these summaries provide a record of what occurred in a particular season, erroneous conclusions can be drawn when the means are presented in summaries. Hellmann (1988) found that a major factor contributing to these errors was the large variability that existed between the individual fields comprising the mean.

The computer software which has been developed to store, extract and manipulate field record data has widened the scope and flexibility of the analysis and interpretation of these data. Hellmann (1993) has demonstrated how to measure and reduce the variability in the data and how the use of some statistical analysis can enable valid comparisons to be made between different 'treatments' comparisons.

- *Tc/ha frequency distributions*

The tc/ha frequency distributions for three growers with similar mean yields for a season are shown in Figure 5. It is interesting to note the wide range of each distribution and that the shape of the distribution varies for each grower. Each field in the different ranges can now be investigated to establish whether or not the performance is the result of a factor that can be altered (e.g. variety) or not (e.g. soil depth).

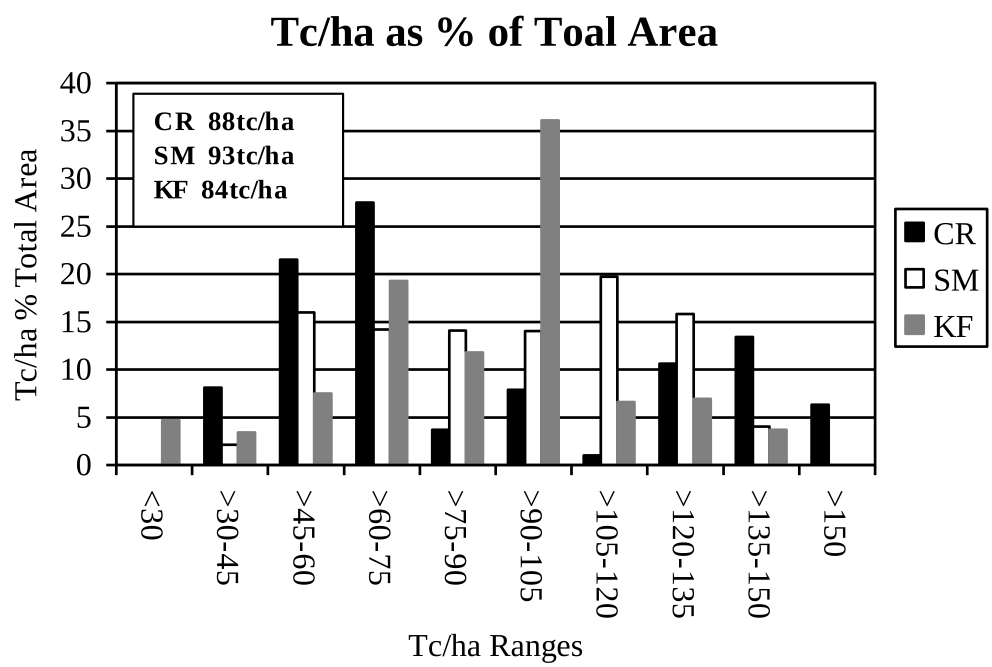

Figure 5 Frequency disposition, based on field data, for three growers

- *Growth cycle analysis*

In order to reduce the variability that exists between fields, it has been found that the yield data from each field should be grouped into different 'growth' cycles i.e. group fields which have experienced similar growing conditions. This has been done for a high altitude farm for the 1986 to 1993 period (Table 3). This analysis has demonstrated that there can be differences between growth cycles. It is at this stage that the individual field data are investigated further by looking at the varieties, soil type and fertility status of the soils.

Growth Cycle Analysis - High Altitude
1986 - 1993

	PSW2	PSW2	PSS2	RSS1	RWS1	RSW2	RSS2	RWW2	RWS2	RWW1
No Fields	1	10	34	13	5	56	42	38	17	2
Area %	0.2	4.0	15.7	4.2	1.8	25.2	21.1	18.1	9.0	0.8
Age(mths)	17.0	21.0	24.2	13.1	14.7	20.9	22.9	23.3	26.9	17.7
Tcane/ha	**68.0**	**94.0**	**108.7**	**67.6**	**61.6**	**90.6**	**101.7**	**88.1**	**104.3**	**97.0**
Std Dev		29.9	21.8	23.6	24.2	21.6	23.3	15.8	17.9	18.4

P=Plant W=<August 1/2=No of summers
R=Ratoon S=>July

Example: Difference between RSS2 and RWW2 = 13.6 tc/ha
Standard error difference of the mean = 4.4 tc/ha
95% confidence limits of comparison = 4.8 to 22.4 tc/ha

Table 3 A growth cycle analysis for a high altitude farm

- *G.I.S (Geographical Information System)*

When investigating data from individual fields, the ability of GIS to link a number of databases together, the data query facilities available and the spatial presentation of the data makes it a very useful tool. Hellmann *et al* (1995) have demonstrated the effectiveness of this software. Tables 4 and 5 are reproduced from this investigation to demonstrate the benefit of having access to a GIS.

Field No	Var	Crop	Previous h/date	Harvest date	Age (mth)	Rain (mm)	Tc/ha
403	N12	2	Nov-90	Aug-92	21.5	1320	109
594	N12	4	Nov-90	Sep-92	21.9	1327	105
551	N12	4	Nov-90	Sep-92	22.4	1333	103
506	N12	5	Oct-90	Aug-92	21.4	1329	95
542	N12	4	Nov-90	Aug-92	21.6	1335	93
401	N12	2	Nov-90	Aug-92	21.5	1320	78
582	N12	4	Nov-90	Sep-92	22.1	1327	77
541	N12	3	Oct-90	Aug-92	21.4	1335	73
552	N376	3	Nov-90	Sep-92	22.4	1332	50

Table 4 Yield, variety, crop status and growth cycle of the fields investigated

For GIS to successfully extract data from the various databases it essential that the number identifying a specific field be identical in all databases. This is likely to be a problem in practice and, at best, some editing will be required.

The aim of the investigation was to identify reasons for the variation in yield obtained for fields grown the same growth cycles.

Field No	Slope position	Aspect	SPM	Soil form	Clay %	PDI	ASI%
403	T/M	SW	TMM	G/D	25-35		5.4
594	M/B	NE	TMO	D	<15		38.7
551	T	E	TMM	G	>35	S	34.0
506	B	E	TMO	D	<15		2.7
542	M/B	NE	TMO	W	25-35		11.5
401	T/M	SE	TMM	H	<15		31.5
582	T	E	TMO	H	>35	M	33.4
541	T	NE	TMO	W	25-35	M	38.4
552	T	E	TMM	H	>35	S	46.5

Slope position: T=top, M=middle, B=bottom
Soil parent material (SPM): TMM=Table Mountain Mistbelt
TMO=Table Mountain Ordinary
Soil form: G=Glenrosa, H=humic, W=well drained, D=poorly drained
P fixation (PDI): M=moderate, S=strong

Table 5 A summary of field data obtained from overlaying the field boundary map on the field description maps generated by GIS

The data indicates that well drained soils appeared to be associated with the low yielding (LY) fields and the high yielding(HY) fields with soils with an E horizon or plinthic layer. The well drained soils tended to be situated in a top slope position, while the soils with impervious layers tended to be found in mid to bottom slope positions. It is felt that fields lower down the slope received extra moisture from higher up the slope. This proposal needs to be investigated further.

The soil analysis data indicates that phosphate fixation could be a factor contributing to the low yields. The proposed Aluminium Saturation Index (ASI%) threshold value of 40% for variety N12 (Shroeder *et al*, 1995) is confirmed by the HY fields with ASI% values approaching 40%.

This study demonstrates that the yield obtained from a specific field is determined by more than one factor. It should be kept in mind when interpreting farm yield data that yields are unlikely to be affected by a single factor.

Other databases

- *Fertilizer Advisory Service (FAS)*

  The FAS database contains all the soil sample analyses that have been tested since 1980. To date, this database has not been used to investigate fertility trends in the district, but has been used extensively on an individual farm basis. The database was used in the investigation reported in the previous GIS section.

  A scanning of the database did, however, indicate that the category 1 soils (low in organic matter) in the district were deficient in calcium and magnesium. The affected growers were notified in order that they could take corrective action.

- *Pest and Disease data*

  Large amounts of survey data has been accumulated since the LP&DC committees were established. It is felt that better use could be made of this data to monitor trends in diseases and/or pests. Currently the data is summarized on a monthly basis only.

Conclusions

It is felt that the ‘computer’ has made available large amounts of information to extension staff and that with the current rate of technology development, the quantity and diversity of data is likely to increase.

This information is assisting extension staff to understand their districts in more detail and to identify those factors which are limiting cane production.

This improved knowledge of the cane growing conditions should lead to better recommendations being made to growers. Being able to measure performance and to communicate this information to growers should stimulate growers to adopt new practices or to change from practices which are shown to be detrimental to cane growth.

With this information at the disposal of extension staff, it should be possible to respond to ‘outside consultants’ who try and promote untested practices in the district.

The computer does not replace the need for extension officers to be active ‘in the field’. It is a tool which can be used to complement or confirm observations made in the field. On the other hand, the results of investigations carried out using a computer need to be confirmed on the ground.

Whenever commercial data is used for an investigation, the temptation to merely summarize the data to a single factor must be resisted. If this is to be done, a measure of the variability of the data making up the mean must be made a reported.

Acknowledgements

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