SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION

ANNUAL GENERAL MEETING

29 NOVEMBER 1996

MOUNT EDGECOMBE

SOUTH AFRICAN SUGAR INDUSTRY AGRONOMISTS' ASSOCIATION

ANNUAL GENERAL MEETING 1996

Time : 08.45

Date : 29 November 1996

Venue : Conference Room, SASA Experiment Station

PROGRAMME

08.45 - 08.55	Chairman's address	
08.55 - 09.30	The world sugar scenario	Mr MJ Mathews
09.30 - 10.00	The implications of productivity changes on growers' profitability	J Chadwick
10.00 - 10.30	Identifying research to reduce costs	EO Hulbert
10.30 - 11.00	**TEA**	
11.00 - 11.30	Potential for improved productivity	NG Inman-Bamber
11.30 - 12.00	An MCP perspective	DH Carter-Brown
12.00 - 12.30	Sugar yields and chemical ripening	RA Donaldson
12.30 - 14.00	**LUNCH**	
14.00 - 14.45	Practical measures used to manage eldana in sugarcane	GW Leslie / FC Botha
14.45 - 15.15	YLS in perspective	RA Bailey / CPR Cronje
15.15 - 15.45	Sugar 2000	TJ Murray

SOUTH AFRICAN SUGAR INDUSTRY AGRONOMISTS' ASSOCIATION

THE IMPLICATIONS OF PRODUCTIVITY CHANGES ON GROWERS' PROFITABILITY

By J B Chadwick

1. Introduction:

Over the past year various sugar industry leaders have given the same message while speaking at different forums - the South African sugar industry has to look at its productivity in order to remain competitive in a global environment. Faced with this challenge all role players in the industry are looking at the part they can play. The agronomists have a major part to play in productivity improvement. It is important to identify the areas where agronomists can make the biggest impact and to channel their energies in that direction.

2. What can be done to improve productivity?

Productivity is defined in the Penguin dictionary of Economics as follows:
"A measure of the rate at which output flows from the use of given amounts of factors of production (resources)".

In broad terms productivity can be improved by producing more with the same resources or using less resources to produce the same. Obviously there are a myriad of possibilities in between these two options. For example productivity can be improved by using less resources even if output decreases as long as the extent by which the value of output drop does not exceed the cost savings of using less resources. Should the agronomists' energies be channelled towards cost cutting or towards enhancing yield? That is the question that this paper explores.

3. **Cane Growing Costs:**

Every year S A Cane Growers' Association analyses cost figures collected from a sample of approximately 30% of larger scale growers. These costs per ton are plotted against the cane income per ton in Graph 1. The difference between the costs and price (the margin) has been indexed and plotted against the Consumer Price Index (CPI) in Graph 2. Growers' margins have been increasing at a lower rate than the CPI. In real terms, therefore, growers margins have been decreasing. The margin could be lagging behind inflation either because costs are increasing at a rate higher than the CPI or because the cane income has increased at a rate lower than the CPI or a combination of the two. Graph 3 indicates the latter to be true in that the cane income per ton until 1991/92 lagged inflation. In all of the graphs presented the figures from 1991/92 should be ignored as the sugar cane growing regions in South Africa experienced a devastating drought which affected the total production. Although droughts have been experienced in the past the magnitude and duration of the early 1990's drought was unusual and considered abnormal. Graph 4 indicates that cane growing costs per ton lagged inflation until the drought set in in 1991/92. The poor margins achieved by growers is a result of the cane price rather than cane growing costs. The attention given to cost cutting in the industry has born fruit - if costs had increased at the inflation rate the margins would have been worse.

Costs are a factor of the price of the input and the quantity used. Since there is no indication that the price of inputs have increased at a lower rate than CPI it can be concluded that growers have been using less per unit output. Alternatively, the output could have been increasing faster than the increase in input usage through technological improvements. This possibility is explored in Section 4 and found not to be the case. It can be concluded that in the case of total inputs growers have been using less every year to produce the same output.

Although costs as a whole have reduced in real terms prior to 1991/92 there may be some cost centres that have increased. Graph 5 and 6 indicate the major cost centres in the dryland and irrigated areas respectively. The largest cost items are labour, transport, machinery and fertiliser. The miscellaneous expenditure is made up of administration, insurance, fixture maintenance, services and sundry as shown in Graph 7. Looking at each of the major cost centres (Graphs 8 to 11) it is evident that labour and fertilizer costs per ton have increased at a lower rate that the CPI. Machinery costs per ton have fluctuated around the CPI.

Transport costs per ton showed a significant upward shift in 1984/85 due to the implementation of the findings of the Rorich Commission where growers picked up the cost of transporting cane to the mill. Since that year increases have fluctuated around the CPI.

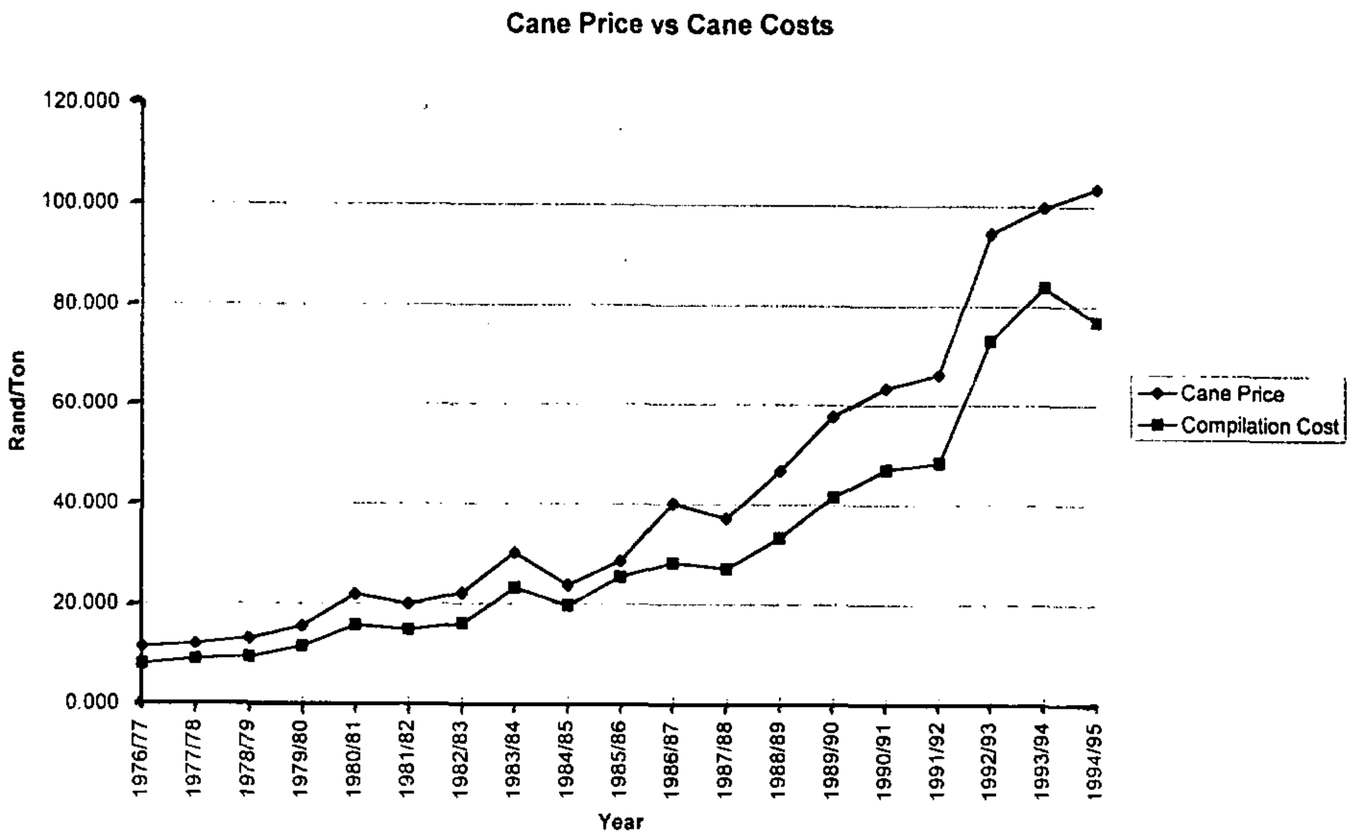
The effect of the falling margin in real terms has been a marked increase in indebtedness as illustrated in Graph 12. This has impacted severely on growers as interest rates have increased at the same time. The average growers' interest bill has increased from R2,00 per ton in 1984/85 to R8,00 per ton in 1994/95 (Graph 13). In general growers have not decreased their management allowances from the farm which has resulted in deficits in many years. These deficits are financed through additional borrowings. Graph 14 illustrates this point - in seven of the last thirteen years the average grower showed a deficit after meeting interest commitments and management allowances - capital redemption and replacements still had to be financed.

What does this all mean for the Agronomist? Firstly it means that the grower is going to have to spend every rand wisely in the future in order to meet his commitments and control his borrowings. Any advice and research arrived at getting the highest return per rand spent will be vital to long term survival.

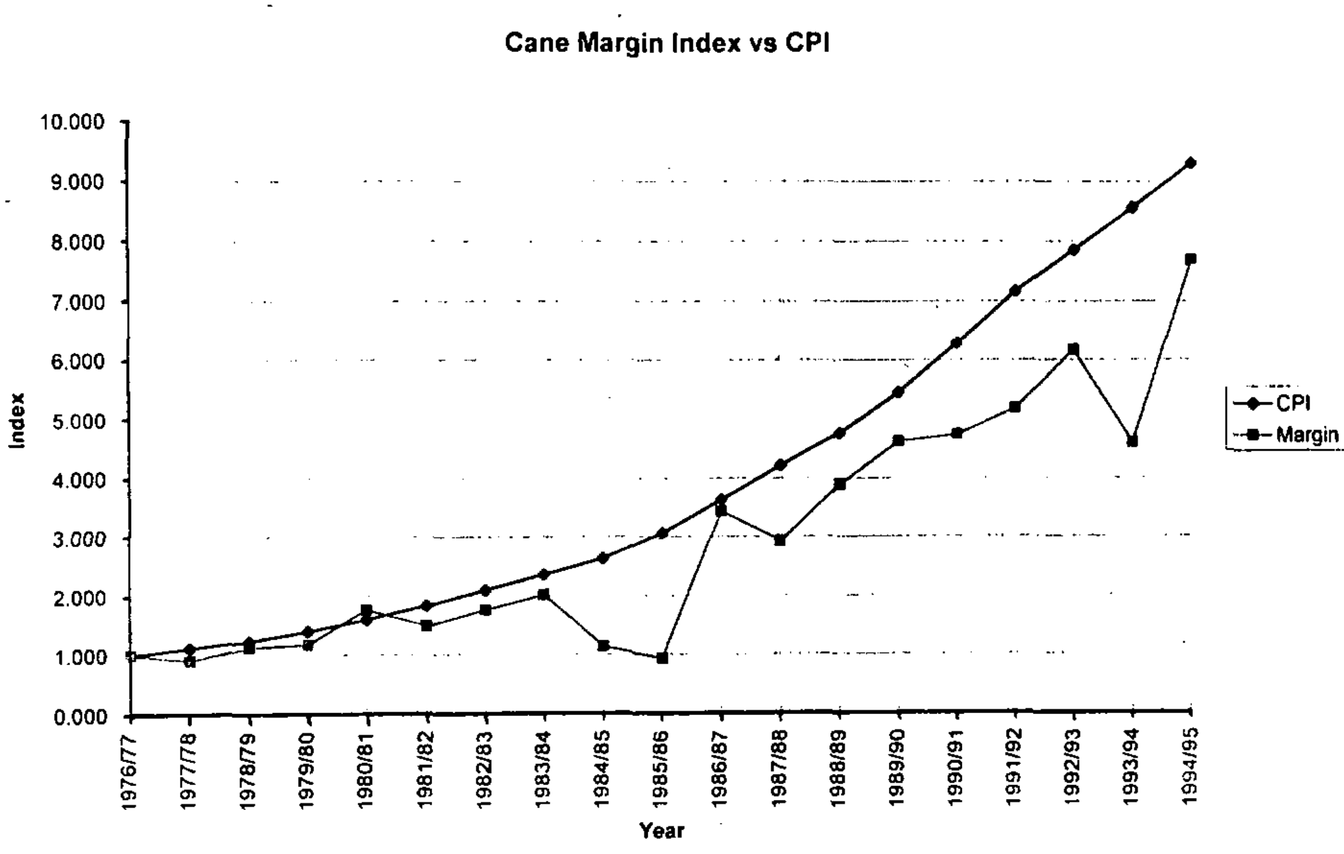
Secondly there is extreme pressure on the major cost centres to increase in the future. Fertilizer prices have increased at over 20% per annum during the past two years. Given the fertilizer industry's policy of import parity pricing the price of fertilizer will in future be linked to the exchange rate. With new labour legislation in place and increased union activity on the farm the cost of labour is likely to increase substantially. Growers who substitute machinery for labour will be faced with higher machinery costs as the exchange rate fall has increased new machinery and parts' prices. Transport costs will be likewise affected, and will also be influenced by higher diesel prices.

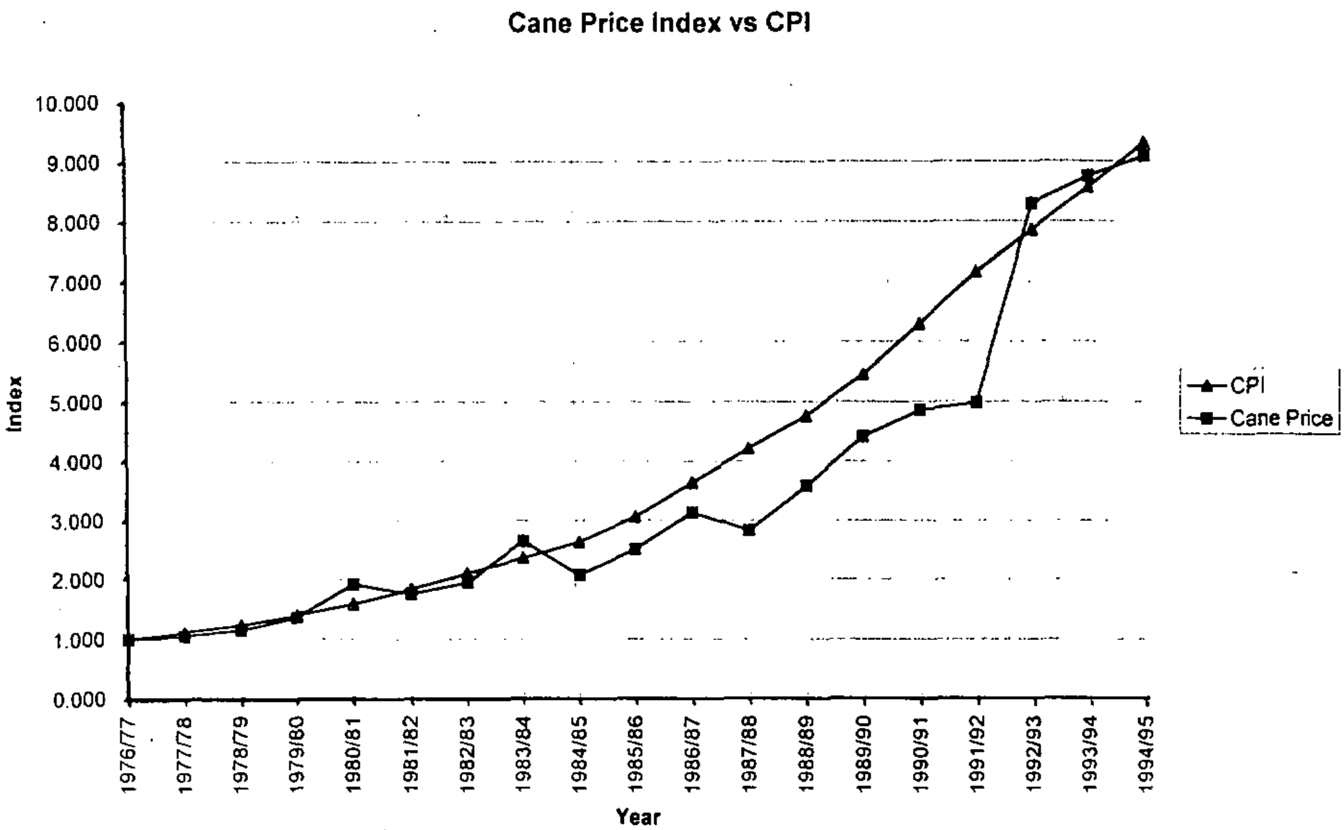
All of these factors mean increased pressure on margins - growers and their advisors will need to ensure that inputs are utilised productively. Costs per ton have been contained in the past - it will be more difficult to contain them in the future.

Graph 1



Graph 2





Cane Price Index vs CPI
Index
Year
CPI
Cane Price
10.000
9.000
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
1976/77
1977/78
1978/79
1979/80
1980/81
1981/82
1982/83
1983/84
1984/85
1985/86
1986/87
1987/88
1988/89
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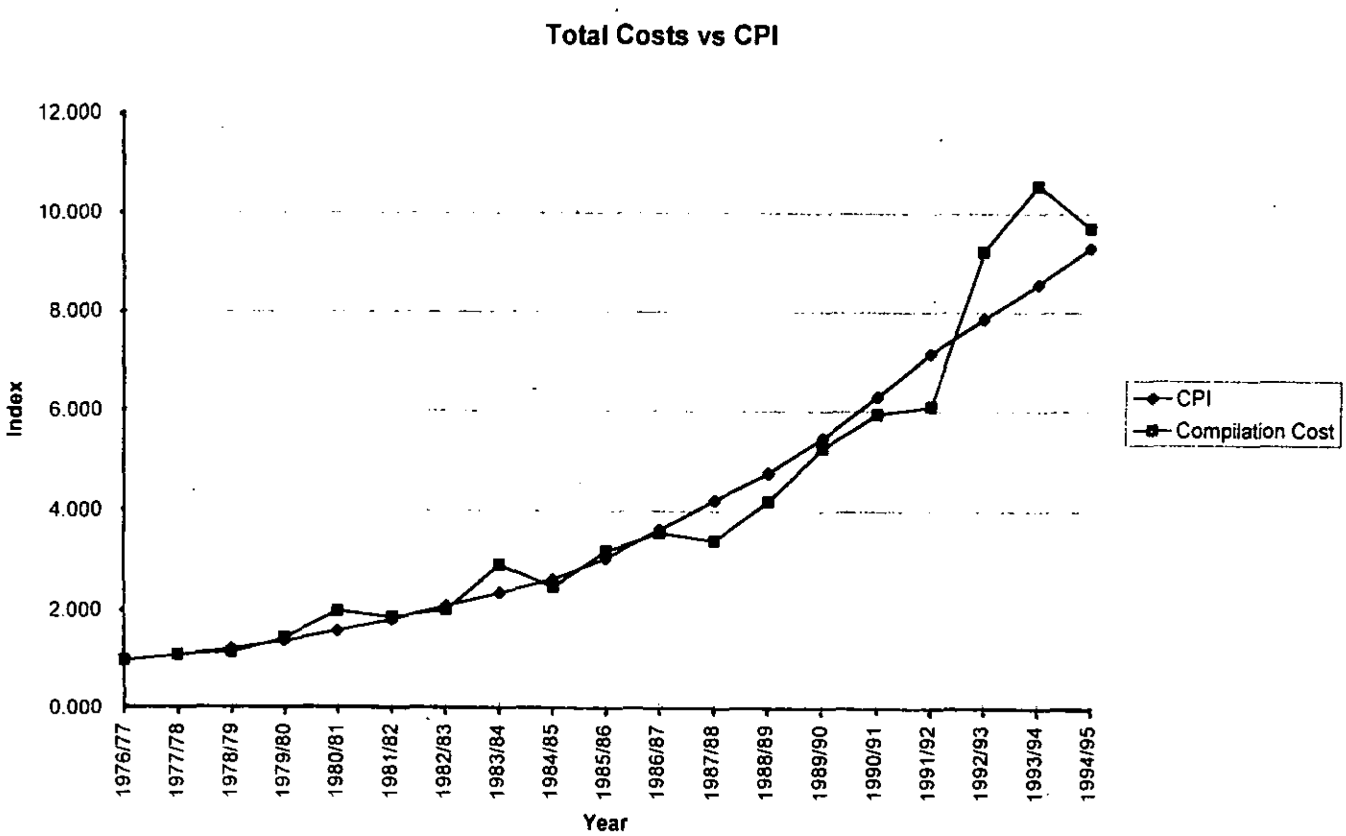
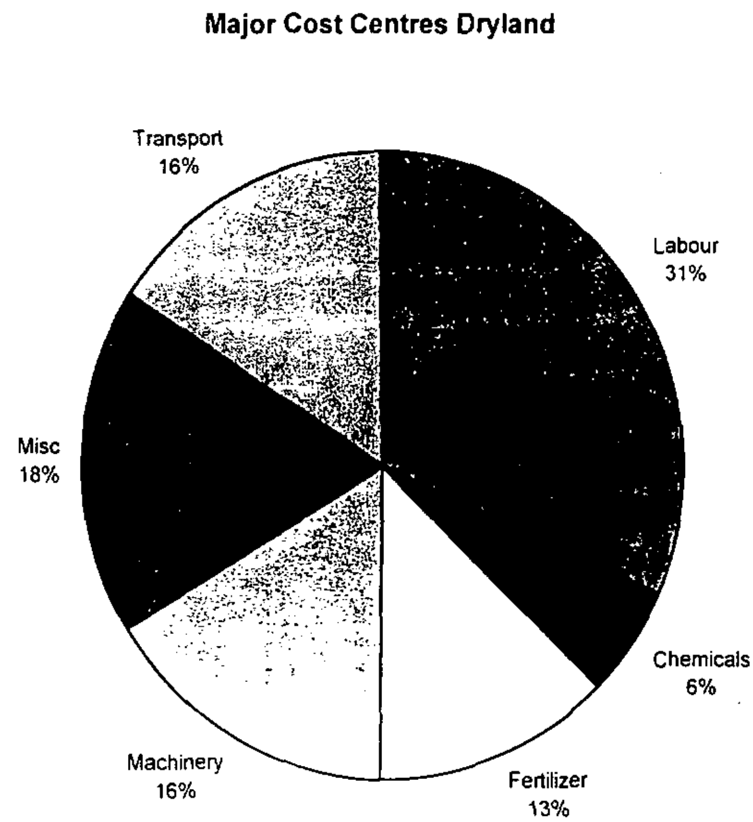
1990/91
1991/92
1992/93
1993/94
1994/95

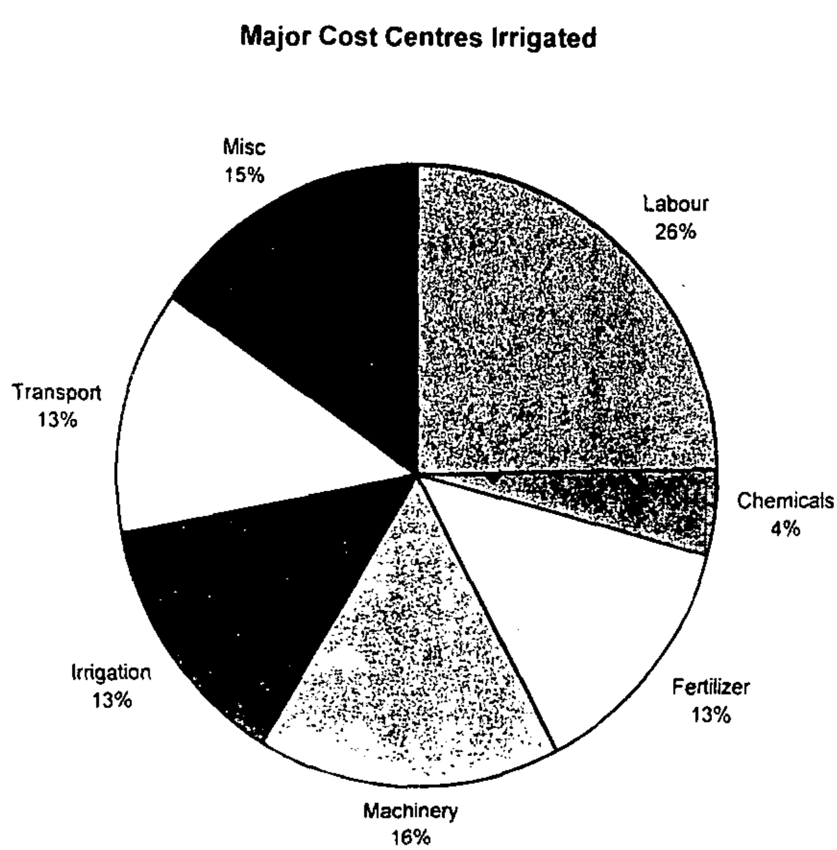


Total Costs vs CPI
Index
Year
CPI
Compilation Cost
12.000
10.000
8.000
6.000
4.000
2.000
0.000
1976/77
1977/78
1978/79
1979/80
1980/81
1981/82
1982/83
1983/84
1984/85
1985/86
1986/87
1987/88
1988/89
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95

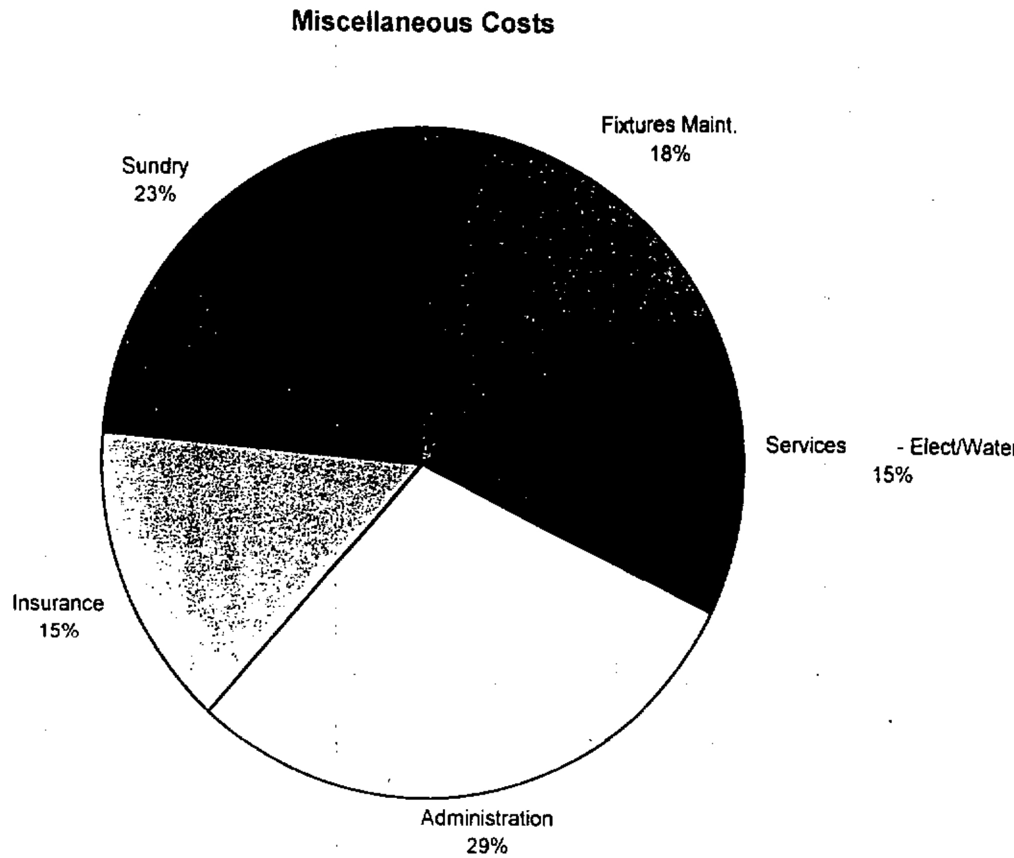
Graph 5



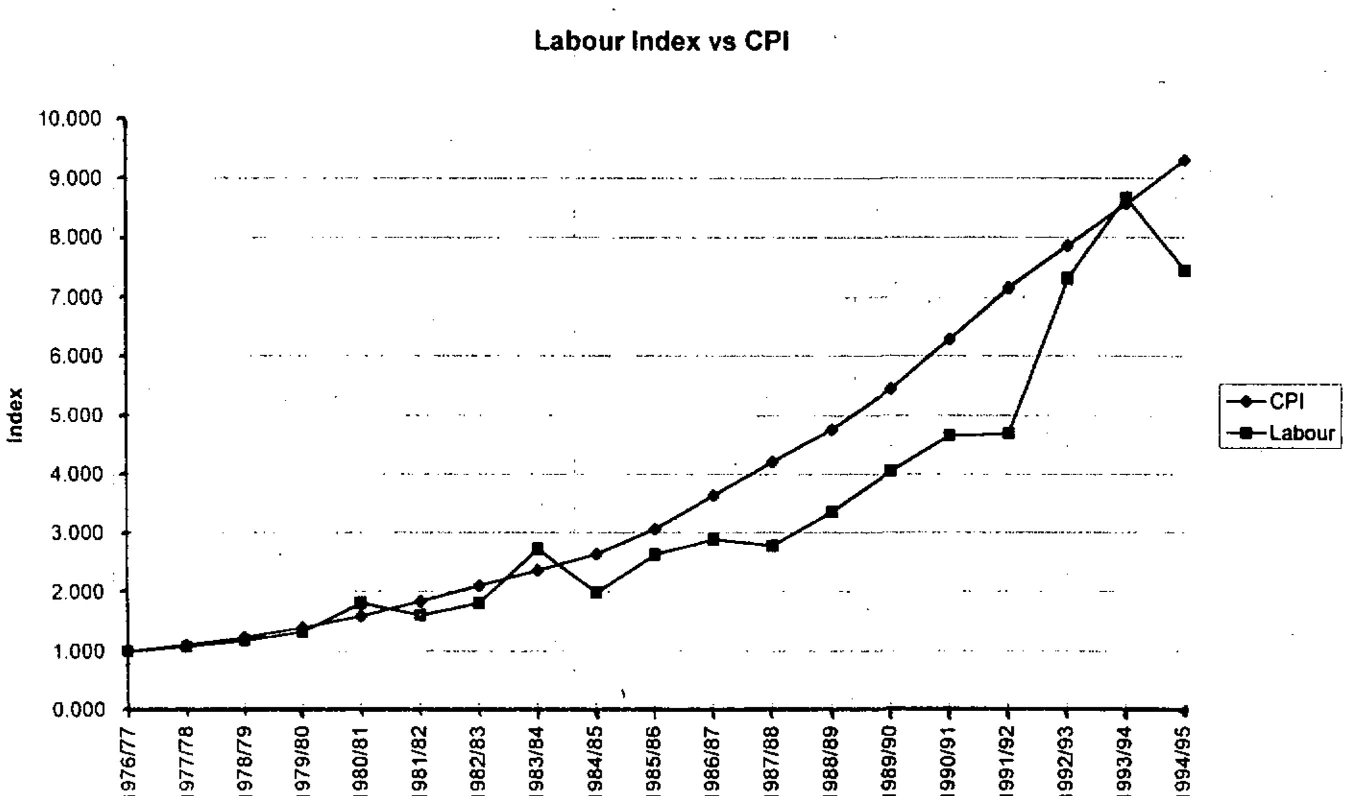
Graph 6



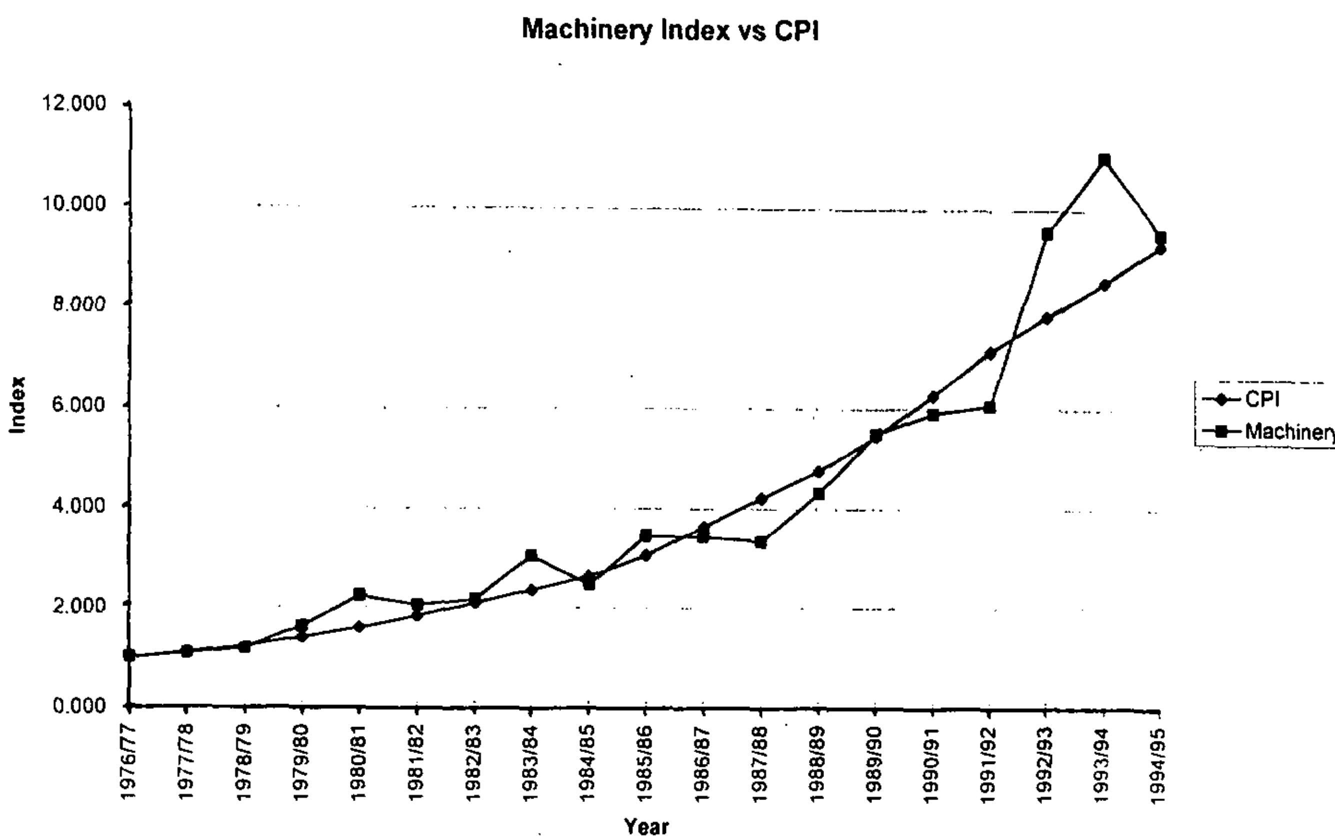
Graph 7



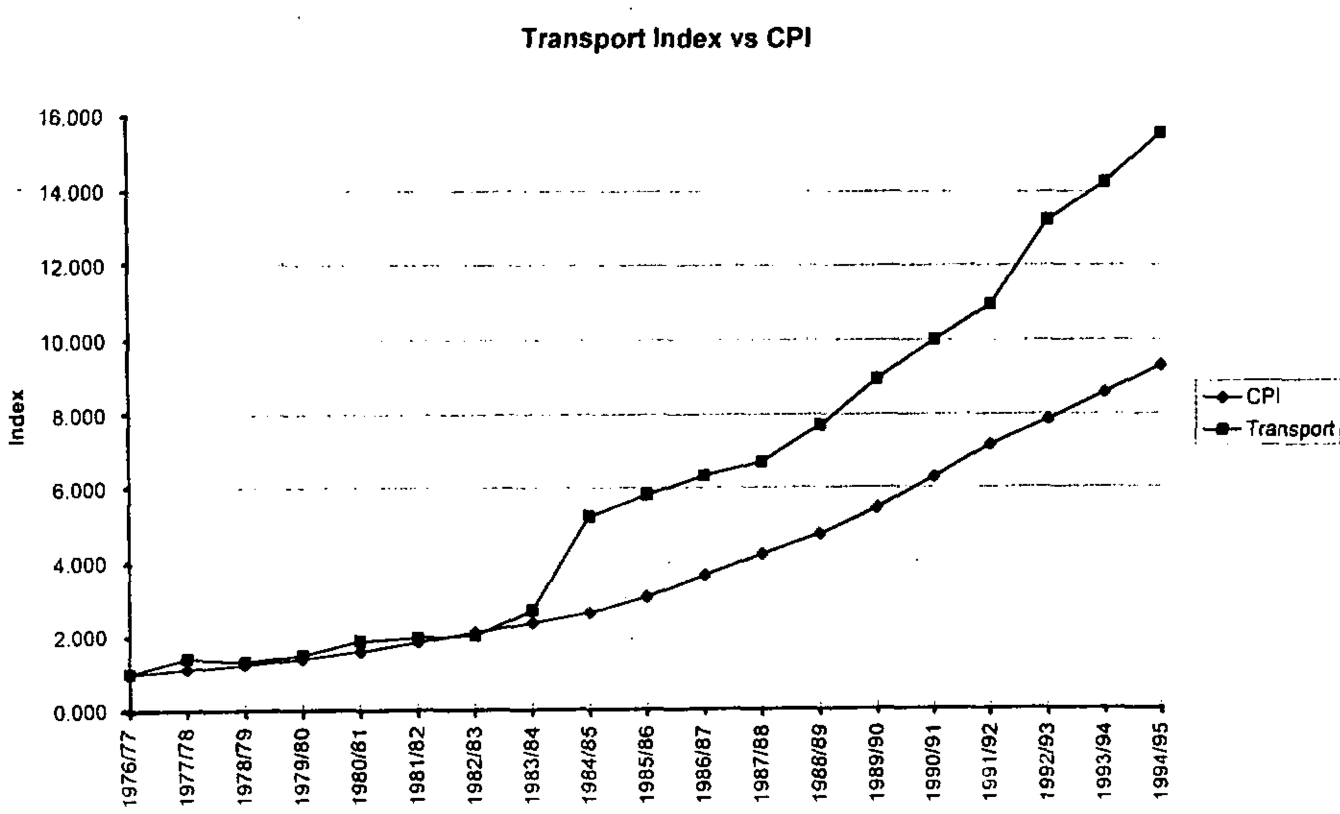
Graph 8



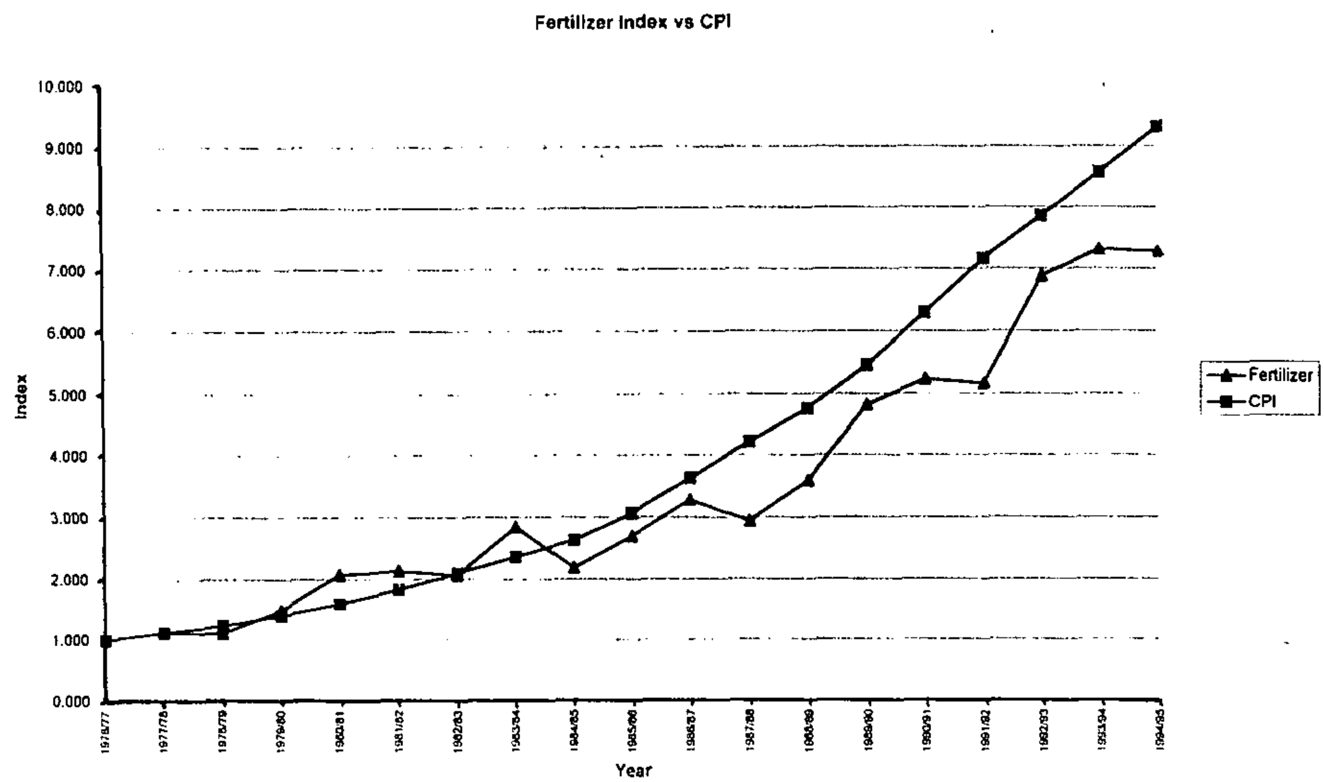
Graph 9



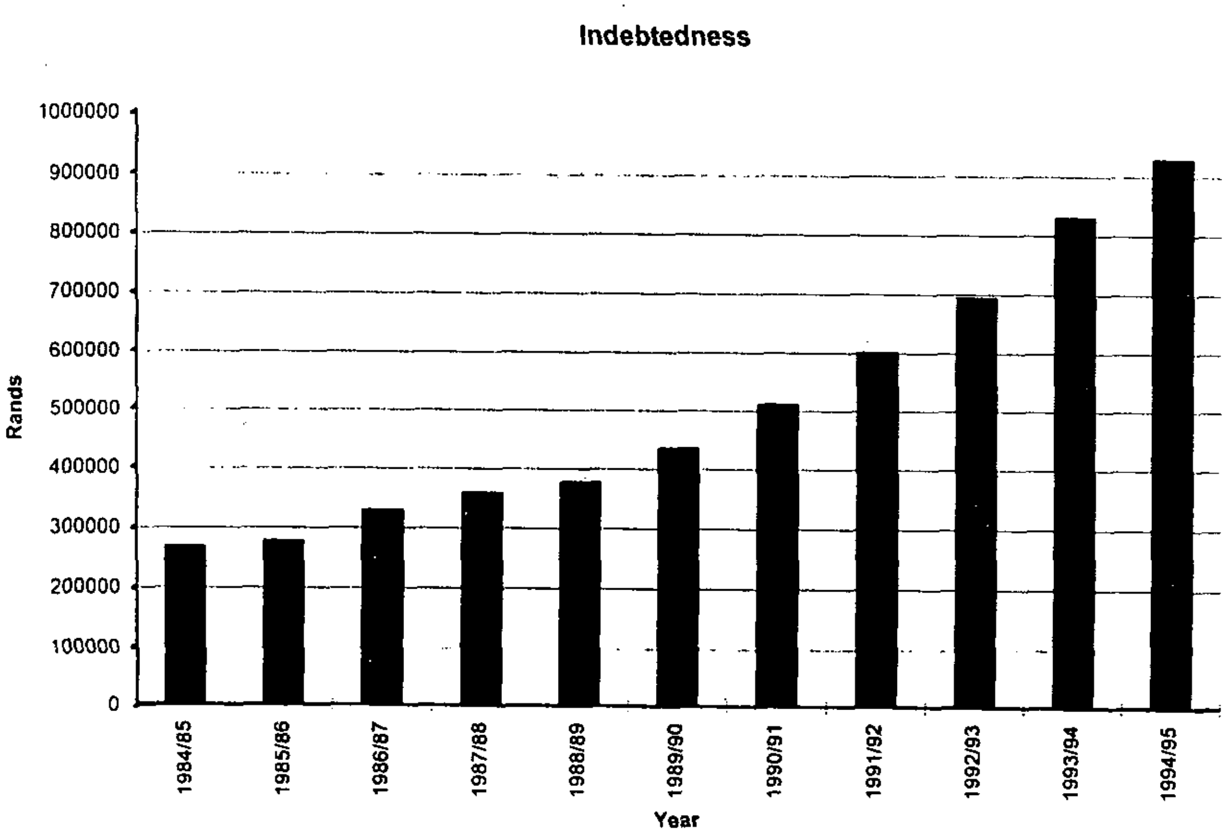
Graph 10



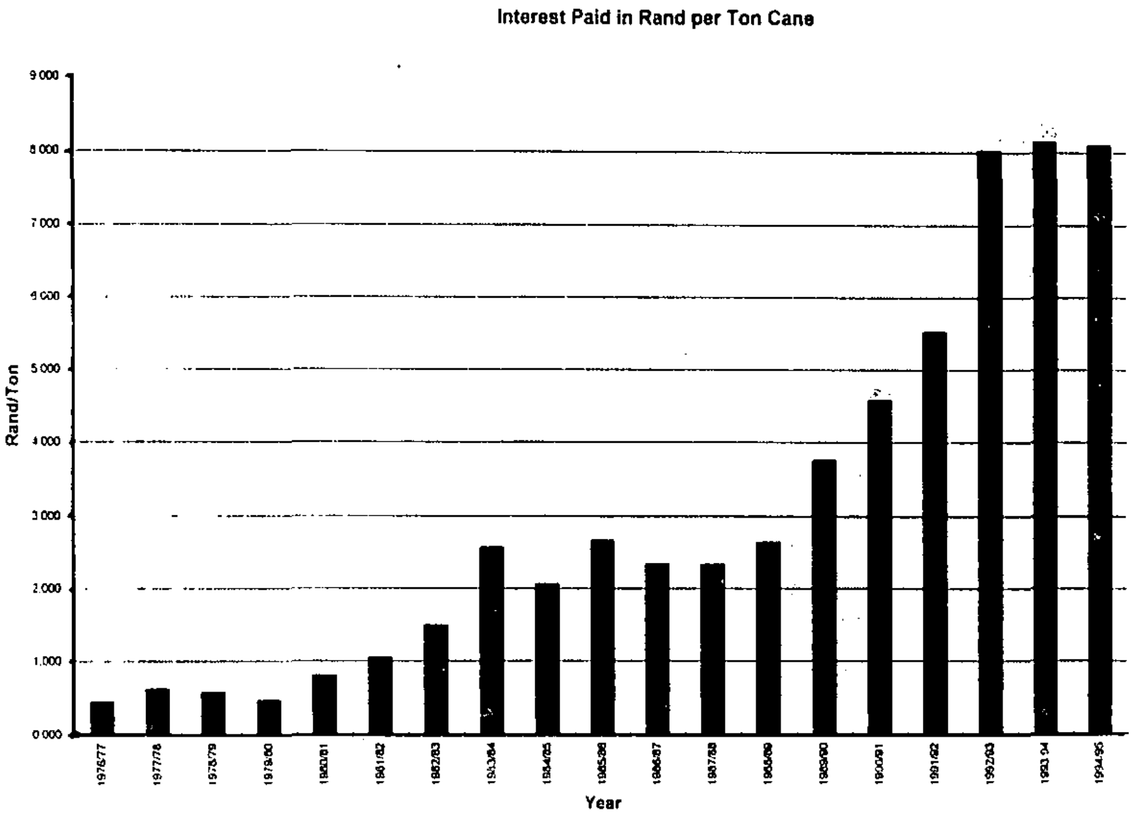
Graph 11



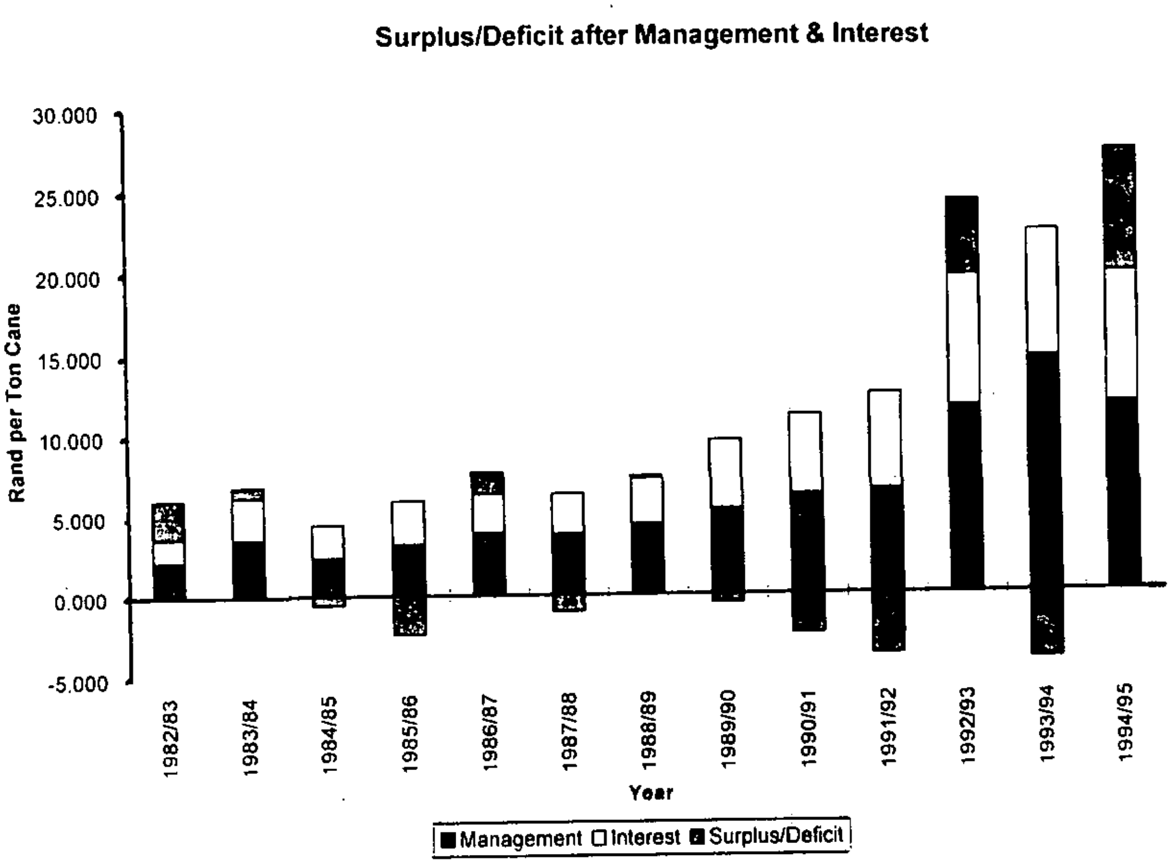
Graph 12

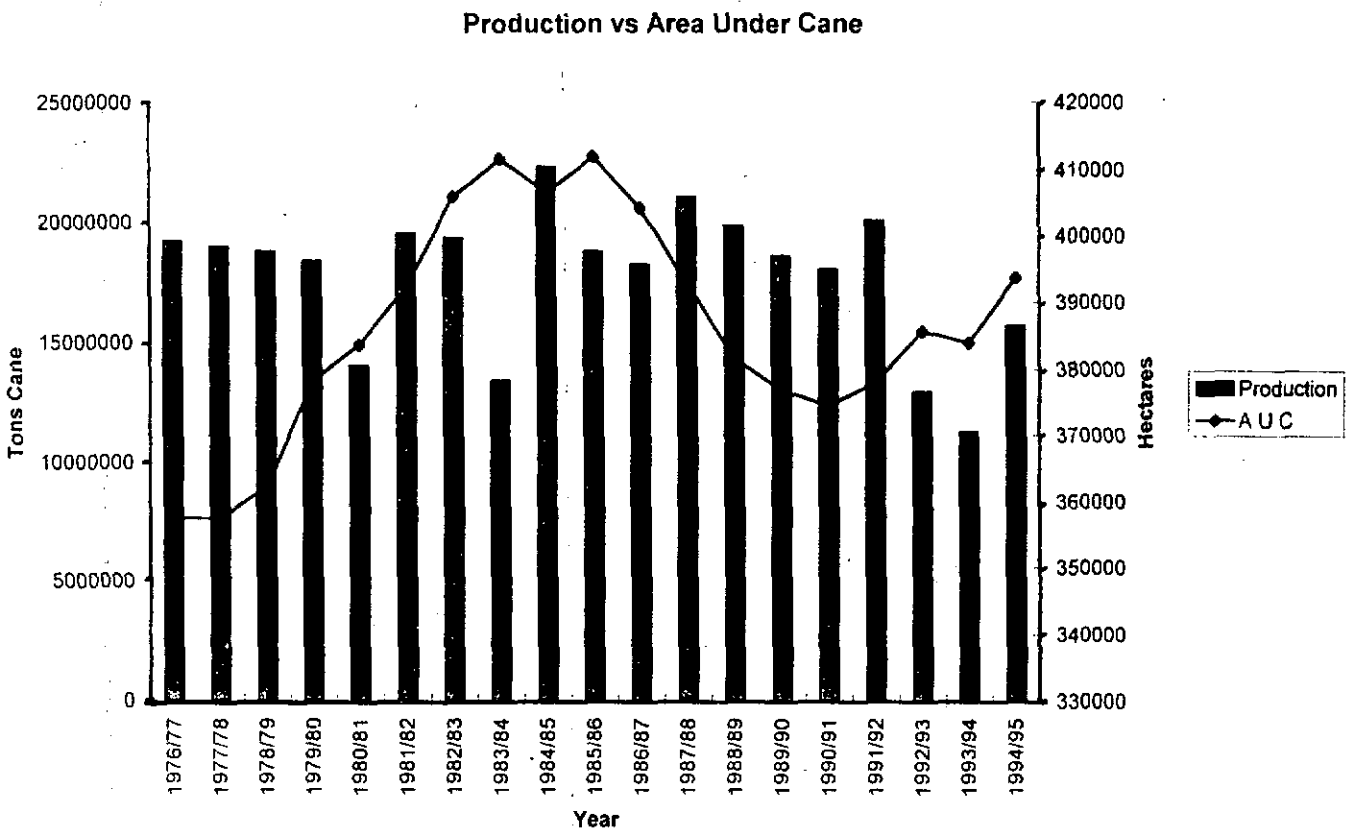


Graph 13



Graph 14




Production vs Area Under Cane
Tons Cane
Hectares
25000000
20000000
15000000
10000000
5000000
0
420000
410000
400000
390000
380000
370000
360000
350000
340000
330000
Production
A U C
1976/77
1977/78
1978/79
1979/80
1980/81
1981/82
1982/83
1983/84
1984/85
1985/86
1986/87
1987/88
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1992/93
1993/94
1994/95
Year

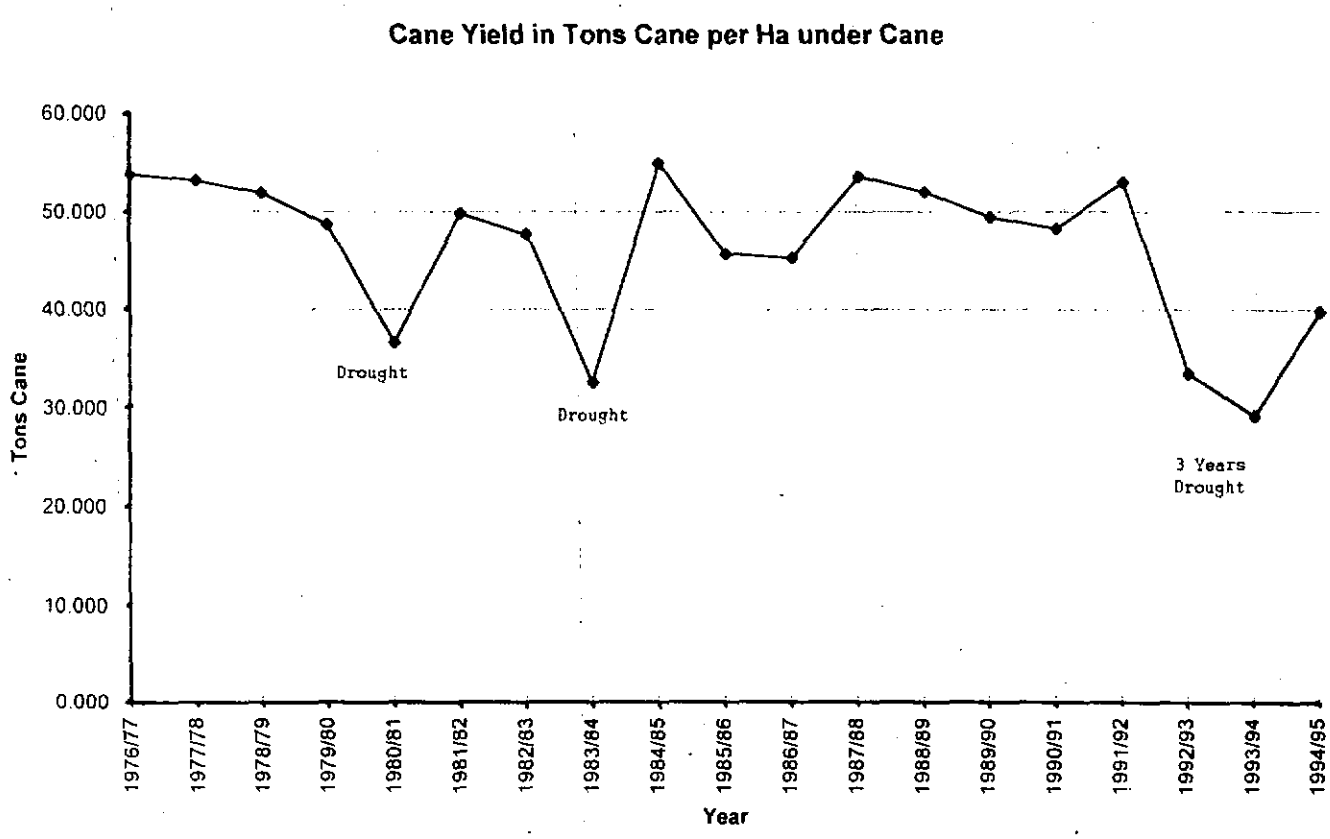
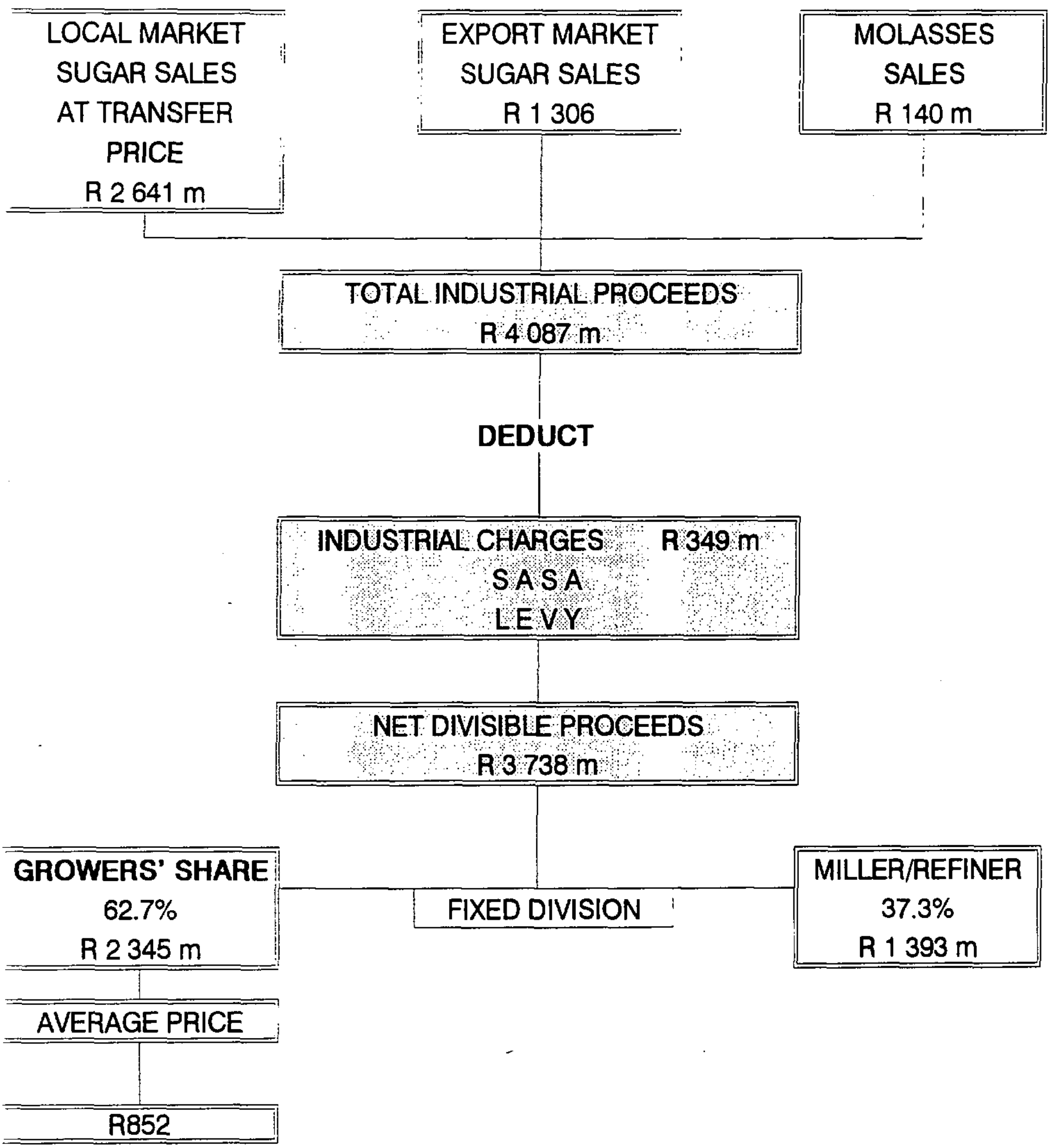

Cane Yield in Tons Cane per Ha under Cane
Tons Cane
60.000
50.000
40.000
30.000
20.000
10.000
0.000
Drought
Drought
3 Years
Drought
1976/77
1977/78
1978/79
1979/80
1980/81
1981/82
1982/83
1983/84
1984/85
1985/86
1986/87
1987/88
1988/89
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
Year

Figure 1

DIVISION OF PROCEEDS 1996/97

ESTIMATED SUCROSE PRICES



1996/97 August Price

Table 1

Table 1 : The Impact of Productivity Improvements on the Sucrose Price

	August 1996 Levels	Yield Increase 3%	5%	10%
Production				
Sugar	2370201	2441307	2488711	2607221
Sucrose	2750504	2833019	2888029	3025554
Local Consumption	1277863	1277863	1277863	1277863
Export Sales	1092338	1163444	1210848	1329358
Molasses Sales	140000000	144200000	147000000	154000000
Export Realisation per ton Sugar	1196	1196	1196	1196
Add Export Realisation per ton Sugar		1087	1087	1087
Domestic Realisation per ton Sugar	1976	1976	1976	1976
Export Proceeds	1306436248	1306436248	1306436248	1306436248
Add Export Proceeds		77292255	128820424	257640849
Local Proceeds	2525057288	2525057288	2525057288	2525057288
Molasses Proceeds	140000000	144200000	147000000	154000000
Gross Proceeds	3971493536	4052985791	4107313960	4243134385
Industrial Charges	234000000	234000000	234000000	234000000
Divisible Proceeds	3737493536	3818985791	3873313960	4009134385
Growers Share	62.70%	62.70%	62.70%	62.70%
Growers Proceeds	2343408447	2394504091	2428567853	2513727259
Per Ton Sucrose	852	845	841	831
Growers Return per Original ton Sucrose	852	871	883	914

Table 2 :Productivity Improvements influence on Growers returns vs Cost Reducing Measures

		August 1996 Levels	Yield Increase 3%	5%	10%
Production					
	Sugar	2370201	2441307	2488711	2607221
	Sucrose	2750504	2833019	2888029	3025554
Price per Ton Sucrose		852	845	841	831
Growers Return per Original ton Sucrose		852	871	883	914
Growers Return per Original ton Cane @ 12.8% Sucrose		109	111	113	117
Difference from Original price per ton Cane			2.38	3.96	7.93
Additional Costs per Ton Cane			0.75	1.25	2.50
Growers Benefit per Original Ton Cane			1.63	2.71	5.43
		1996/7 Budget Figures	Equivalent drop in Costs in order to gain the same benefit		
Costs per ton Cane	Fert	10	16.28%	27.13%	54.26%
	Transport	12	13.57%	22.61%	45.22%
	Chemicals	4	40.70%	67.83%	135.65%
	Machinery	11	14.80%	24.66%	49.33%
	Labour	21	7.75%	12.92%	25.84%
	Miscellaneous	10	16.28%	27.13%	54.26%
	Total	68	2.39%	3.99%	7.98%

4. **Yield Improvements:**

The question may be asked as to whether the emphasis on controlling costs has been at the expense of improved yields. Although the question is difficult to answer it is useful to look at the production levels over the past twenty years (Graphs 15 and 16). Climatic effects play a major role as is evident in the drop in yields in the early eighties and early nineties. Yields per hectare under cane have otherwise shown very little fluctuation around the fifty tons per hectare under cane level. With all the research and extension over the past twenty years yields have not shown any marked increase. Obviously the increase in lower yielding small grower areas and the increase in Eldana activity has had an impact on yield - nevertheless the challenge is to increase these yield levels in the future.

Any increase in yield will result in increased sugar production which will be exported. In order to determine the impact of yield increases on the sucrose price it is necessary to look at the division of proceeds formula. The workings of the division of proceeds for August 1996 are used as the base (Figure 1). The average price achieved by growers would have been R852 per ton. Three production improvements are assumed - 3%, 5% and 10%. In each case the additional sugar produced is exported earning an average price on the world market (lower than the present export realisation due to the influence of preferential markets eg the USA premium). The effect on the sucrose price is shown in Table 1. As the yield improves the sucrose price decreases. The individual grower is now producing more sucrose with the same costs, in the example of the 10% increase he is now producing 1,1 tons of sucrose at R831 per ton sucrose for every ton sucrose he produced at R852 per ton sucrose.

The returns to each grower per ton of original sucrose produced is now R871, R882 and R914 for a 3%, 5% and 10% yield improvement respectively. Converting these figures to rands per ton cane at 12,8% sucrose results in the figures shown in Table 2. For each ton of cane produced the grower benefits by R2,38; R3,96 and R7,93 per ton cane with yield improvements of 3%, 5% and 10% respectively. From these benefits the variable costs of harvesting and transporting the additional cane must be deducted. This yields a nett benefit of R1,63; R2,71 and R5,43 for the three levels of yield increases respectively. In order to determine how costs would have to change to get similar results the budgeted figures from S A Cane Growers' Association's 1996/97 budget survey are used. The budgeted costs per ton cane are shown in Table 2.

The figures in the body of the table indicate the magnitude by which each individual cost item would have to decrease in order to get the same benefit as the yield increase in each case. In other words to get the same benefit as a 3% increase in yields, fertilizer costs per ton would need to decrease by 23,78%.

Perhaps it is time to concentrate energies on yield increases. Although it is important to work on economic optimum levels of production - it may be that cost reduction has been at the expense of yield improvements that could have been economically viable. Agronomists should look beyond the entrenched agronomic practices and see where improvements can be found - for example - is there an acceptable Eldana infestation level or do we have to do everything to keep levels to as close to zero as possible? Why do some fields carry on producing viable yields for over 20 ratoons while others don't? Should the weighting in plant breeding and selection be changed in favour of sucrose yield over pest and disease resistance? These are just some of the areas which could be explored.

It is time for the industry to look at what can be done to improve yields. A lot of work has been done in the past and this should be revisited. Where the cost of implementing yield enhancing measures is high yield response curves should be developed to determine the economic optimum level of resource use.

Growers' implementation of advised changes has always been a problem. This could be either because the grower does not know about the advice **or** because he has his own reasons for not implementing them (eg the increase in management input may interfere with leisure activities). Although it is doubtful that the first option is the problem this may be the case in some areas and should be addressed there. As for the second option growers' financial position has deteriorated to such an extent that they can no longer ignore or avoid the fact that to survive and prosper - they will need to adopt whatever measures are available to improve productivity.

5. **Conclusion:**

Prior to the mid 1970's farmers concentrated on maximising yield regardless of the cost. As the price of inputs increased farmers looked more and more at cost cutting. The emphasis shifted to reducing costs. The evidence suggests that cane growers and their advisors have been successful in containing costs in the past. With the probability of input prices increasing dramatically in the future, growers will need to maintain their control over the use of these inputs in the future.

Yields have remained constant over the same period. This might suggest that the cost cutting exercise has been at the expense of enhancing yields. While it is not proposed that growers revert to producing the maximum at any cost, it may be time to re-evaluate yield enhancing measures to determine their applicability. Where necessary yield response curves could be determined to find the economic optimum level of input use.

I believe the challenges to the Agronomists in the future are:

- to control costs in an environment of ever increasing prices
- to break out of the present restricted yield levels

SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS ASSOCIATION

IDENTIFYING RESEARCH TO REDUCE COSTS

By EO Hulbert

INTRODUCTION

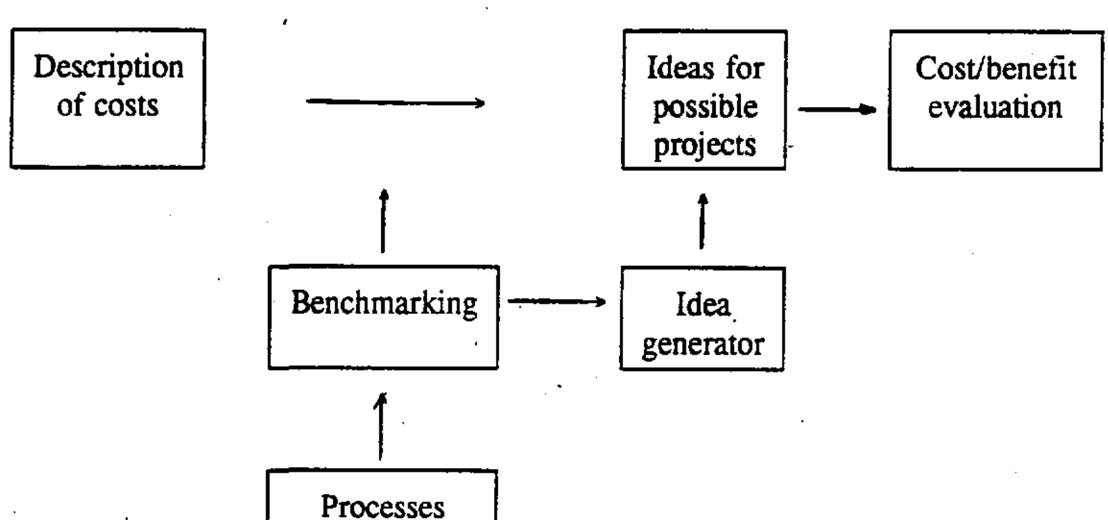
Agronomists have always been concerned with attempts to reduce costs of production, for example in 1986 the theme of the symposium was cost reduction and last year most of the papers presented had a similar objective. Over the years economists have earnestly gathered information on production costs for sugar price determinations, every producer needs a cost component for his budget and industry leaders and consultants have emphasised the importance of reducing costs to maintain or improve profitability.

Research at the Experiment Station inevitably has to become involved in cost reduction, for example the control of eldana will increase yields as well as reduce costs. Nevertheless, the emphasis on breeding higher yielding varieties has meant that improving productivity has probably been the main driving force.

These notes describe a process whereby a group of thirty people at the Experiment Station tried to specifically identify ideas for possible research projects that would lower the costs of production of sugarcane.

STEPS IN IDENTIFYING RESEARCH

The steps followed during the course of the six hours session (not continuous) are as follows:



DESCRIPTION OF COSTS

A few sources of costing were available for the exercise but most were not designed to evaluate costs of infield agricultural operations. It was decided to use data derived from a SASTA paper (1996) published by the author and this can be found in Appendix I.

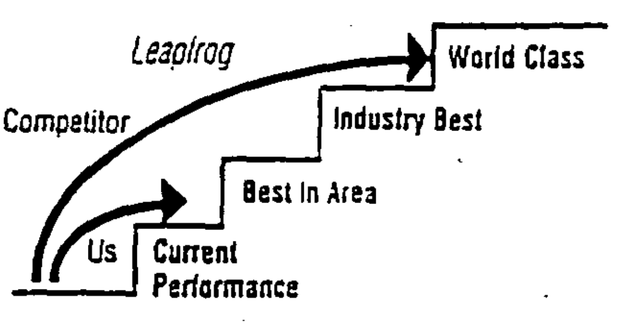
These costs are direct or variable costs, in Rand/hectare harvested, of the four major agricultural operations. Contributions to costs came from labour, materials and machinery. The data in Appendix I highlighted the main areas where 24 sugarcane producers on the North Coast spend their money on agricultural costs during the 1994/95 season agricultural operations. In order of importance they are:

1.	Fertiliser for ratoons/irrigation costs*	27%
2.	Re-planting (10% re-plant)	20%
3.	Infield haulage costs	20%
4.	Cutting costs (manual harvesting)	17%
5.	Weed control	11%
6.	Seedcane (10 tons/ha)	7%

* source - SACGA

BENCHMARKING

The concept of benchmarking was introduced in an attempt to motivate thinking beyond small incremental changes in cutting costs.



However, benchmarking is a disciplined management approach and in the system described by The Quality Network there are 10 major steps to be completed. The selection of a process to benchmark is one of ten activities in Step One! The elements of a Process can be found in Appendix 2.

Each agricultural operation needs to be described as a process, for example manually cut and bundled/windrowed cane can be handled in various ways as described by Eddie Meyer in Appendix 3. Each process would need to be described in more detail in a benchmarking exercise before one could be costed against another. Each process can then be compared with the best within or without an industry.

Finally, an important aspect of benchmarking would be that the customer would always be considered, for example the quality of the cane delivered by each harvesting and transport system would need to be taken into account.

IDEA GENERATOR

The participants were divided into groups of five, and in order to help manage the ideas generated by each group, 'The Idea Generator' software was available on a laptop.

IDEAS IDENTIFIED FOR RESEARCH THAT WOULD REDUCE COSTS

Each group was free to choose one or more topics from the description of costs in Appendix 1 and in the event the major cost centres were chosen. The results of all the groups thinking are listed under each topic in Appendix 4. For convenience the ideas were classified into those that need researching, need more research and those that can be implemented immediately. The final grouping is a by-product of the exercise and therefore not, by any means, a comprehensive list of present knowledge.

FINAL COMMENT

Members of the Experiment Station still have to take the final step of doing a cost/benefit exercise on each idea that has good potential for reducing costs of production before it can be considered for addition the to work programme. The Experiment Station would welcome further ideas from members of the Agronomists Association, especially if a cost/benefit exercise has been completed!

Exercises such as these will help put a Rand value on ideas that may have been around for some time, and focus thought on their true impact. For example, selection for self-trashing might be shown as needed for the survival of the industry when its contribution to eldana control, cane quality, soil protection and the environmental need for green cane harvesting is taken into account.

ACKNOWLEDGEMENTS

All 30 members of the Idea Generation Team.

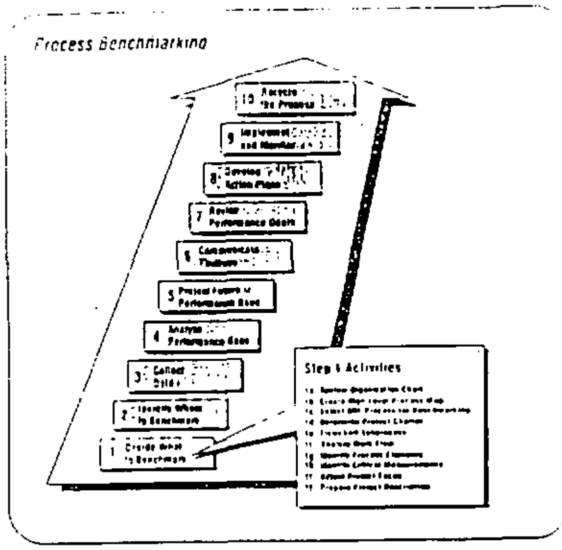
ADC : RAND/HECTARE HARVESTED

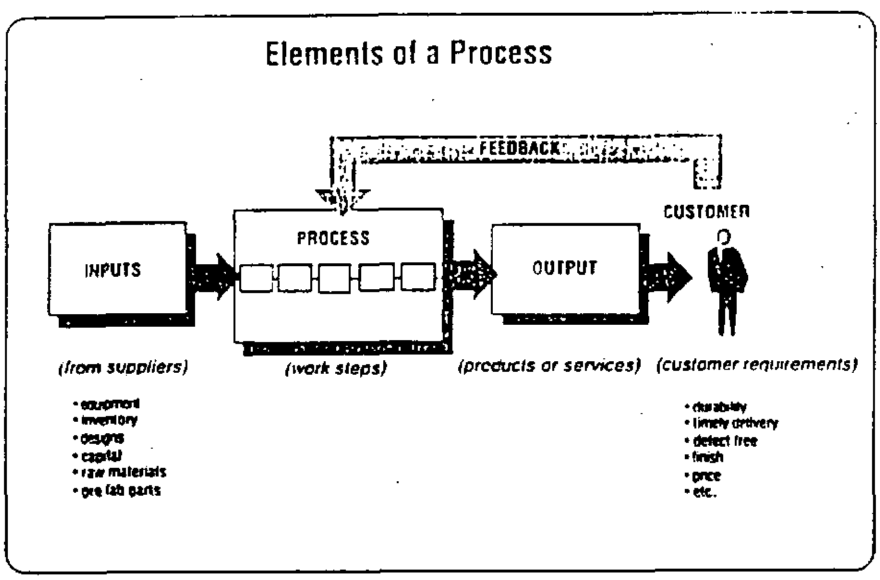
	Labour		Materials			Machinery				Total
	Wages	Rations	Fertiliser	Chemicals	Other	Tractor	Trailer	Loader	Fuel & lubricants	
Cutting & stacking										
Cutters	220,9	38,6								259,50
Induna	38.6	2.0								40.60
Loading & infield										
Infield haulage	48,0	9,5				120.1	34.3		110.6	322.50
Mechanical loading								38.93		38.93
Ratoon maintenance										
Trash management	9,17									9,17
Nematicides				21.04						21.04
Fetiliser	8,1		480.3							488.40
Weed control	62,9			142,7						205.60
Verges & breaks						50,7				50.70
Planting										
Stool eradication	5,2			9,9		42,2				57,30
Planting operation	32,6		69.6	24.5	114.5	17,8				259,00
	425,47	50,1	549.9	198.14	114.5	230.8	34.3	38.93	110.6	1 752,74
	475,57		862,54			414,63				

ADC : % DIRECT COSTS

	Labour		Materials			Machinery				Total	
	Wages	Rations	Fertiliser	Chemicals	Other	Tractor	Trailer	Loader	Fuel & lubricants		
Cutting & stacking											
Cutters	12,6	2,4								15,0	17
Induna	2.2	0.1								2.3	
Loading & infield											
Infield haulage	2,7	0,5				6,7	2,0		6,0	17,9	20
Mechanical loading								2,0		2,0	
Ratoon maintenance											
Trash management	0,5									0,5	
Nematicides				1,2						1,2	
Fetiliser	0,4		27.1							27,5	43
Weed control	3,4			7,8						11,2	
Verges & breaks						2,9				2,9	
Planting											
Stool eradication	0,3			0,6		2,4				3.3	20
Planting operation	1.9		3.9	1,4	7,0	1,0				15.2	
	24	3	31	11	7	13	2	2	6		
	27%		49%			23%				100%	

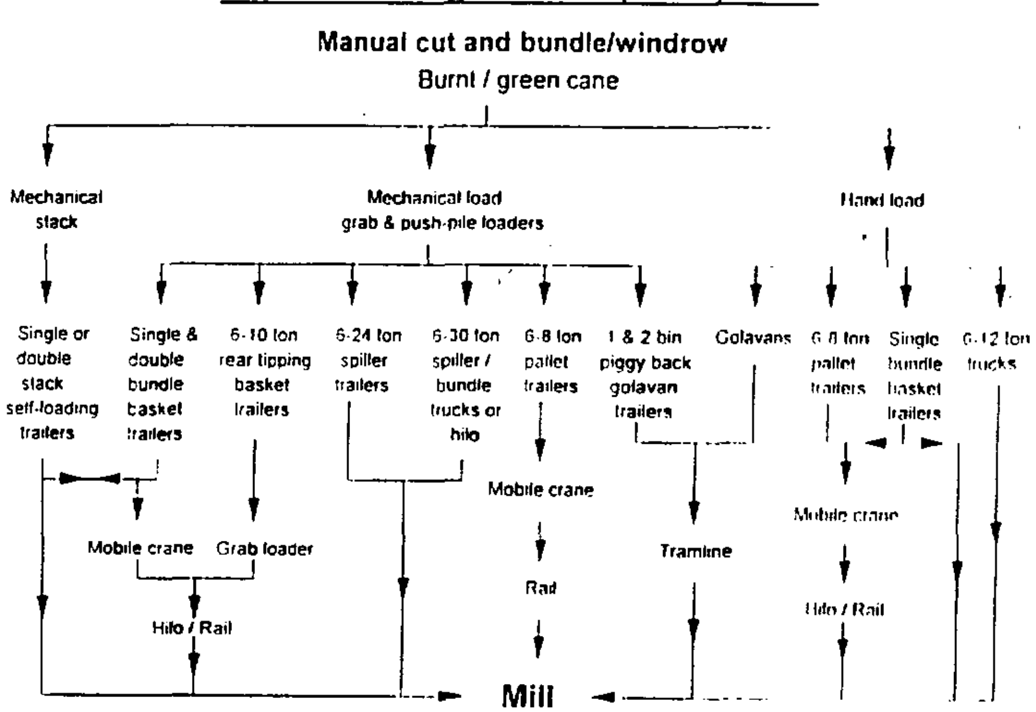
APPENDIX 2





APPENDIX 3

Cane harvesting and transport systems



POSSIBLE IDEAS FOR RESEARCH TO REDUCE COSTS

1. REDUCING COSTS BY IMPROVED FERTILISER EFFICIENCY

Research:

- *Incorporate climatic risk in fertiliser recommendations
- *Soil micro-organisms (*Mycorrhizeae* for P)
- *Varieties with N fixing potential
- *Genetic/physiological work on nutrient transport systems
- Some tillage in minimum tillage to promote N release
- Better placement of fertiliser, e.g. burying
- Genetic engineering for better N fixation
- Identify genes responsible for translocation in the plant
- Improve soil diagnostic procedures, e.g. organic matter

Management/Research:

- *Analysis of existing data and new work on placement and timing of fertiliser application
- Inter-cropping with legumes as a possible reducer of fertiliser
- Timing of fertiliser application to prevent loss/leaching
- Advice for ratoon crops beyond 4th ratoon cycle
- Pre-planting seedcane fertiliser advice
- Adjust fertiliser recommendations for shorter crop cycle, 12 vs 24 months
- Nutrient value of trash
- Green manure as break crops, e.g. sun hemp/soybeans
- Investigate economics of slow release fertiliser

Management:

- Optimise recommendations for different varieties
- Better sampling strategies and training
- Better blending of fertilisers, e.g. cocktails
- Management by soil type
- Fertigation advice for irrigated cane
- Leaf sampling; encourage use of and encourage early sampling
- Improve marketing FAS
- Site specific fertiliser management - precision farming
- Organic alternatives, e.g. filtercake
- Cheaper form of chemicals, e.g. anhydrous ammonia

2. REDUCING COSTS BY INCREASING RATOON NUMBER

Research:

- *Better ratooning varieties
- *Investigate changes in soil biotic (e.g. meso & microflora and fauna)

Management/Research:

- *Investigate changes in soil abiotic factors (i.e. physical and chemical characteristics), FAS data as a source
- Minimise pest and nematode build-up

Management:

- *Minimising soil degradation
- *Quantify need for re-planting
- *Audit old ratoons for longevity (obvious and unknown)
- Maintaining field nutritional status
- Minimise disease spread
- Avoid disease introduction and spread
- Correct management
- Choose best variety for field/farm situation
- Start with disease-free seedcane
- Efficient eradication of old crop
- Minimise disease spread during harvest
- Timely roguing
- Choose resistant variety

3. REDUCING COSTS BY EFFECTIVE IRRIGATION

Research:

Crop/evaporation demand

- *Reducing evaporation through mulching, trash, plastic, polymer
- Reducing evaporation: open water surfaces - surface water
- Assess varieties in terms of water usage:
  Selection varieties = max yields x special water regimes

Soil-plant available water

- *Contributions by water tables when scheduling
- Satellite imagery interpretation (crop stress, waterlogging)

Irrigation systems

- Robust economic model (yield x costs of water)
- Irrigation technology evaluation - joint venture in parallel:
  Sophisticated - closed circuit automated irrigation

Management/Research:

Crop/evaporative demand

- Assess varieties in terms of water usage:
  Released varieties = yields x water usage

Water applied

- *Rainfall predictions (two weeks ahead)

Soil-plant available water

- Stress indicator plots (simple method)
- Reduce run-off (improve infiltration of difficult soils)

Irrigation systems

- Irrigation technology evaluation - joint venture in parallel:
  Appropriate - solar energy, animal power, manual tools
  Disposable, lighter equipment - use, abuse, throw away
- Improving labour productivity with better tools

Management:

Water applied

- time of irrigation
  (daylight x night application x energy x water savings x increased costs)

Irrigation systems

- Key point system efficiency measurements

4. **REDUCING COSTS BY IMPROVING HAULAGE EFFICIENCY**

Research:

- Straight, high sucrose cane
- Simulation of transport vehicle
- On-farm, infield milling

Management/Research:

- Chop cane - improve load density
- Whole plant harvesting
- GIS
- Portable conveyors
- Cableways for steep farms
- Chutes
- *Panela production - small scale growers?

Management:

- Staff training
- Contract out - negotiate costs, conditions .
- Golovans
- Scheduling truck movement, security
- Vehicle configuration
- Loading methods for high density

5. REDUCING COSTS BY BETTER WEED CONTROL

Research:

- *Increase herbicide resistance

Management/Research:

- *Use of low volume equipment (reduce labour costs)
- *Total chemical weed control

Management:

- Timing iro weed growth, climatic conditions
- Identifying shares - identify weeds, weed growth stage
- Availability of capital - availability of chemical stocks
- Seeking expert knowledge - SASEX and Reps
- Similar application methods
- Choice of chemical
- Programming weed control
- Correct application methods
- Application equipment

SOUTH AFRICAN SUGAR INDUSTRY AGRONOMISTS' ASSOCIATION

Potential for Improved Productivity

NG Inman-Bamber

Productivity

Productivity defined as sucrose produced per hectare per annum is limited by;

1. The amount of light intercepted by leaves (R_i)

2. The amount of water transpired by leaves (E_t) of stalks that contribute to yield

3. The mass CO_2 assimilated (C) per unit mass of transpiration (transpiration ratio or $TR=C/E_t$). Options to improve this ratio are limited but they do exist.

4. The fraction of assimilate ending up as sucrose stored in the stalk (harvest index or HI)

Assuming that water and light or the two limiting factors over which we have least control, it is important to define two efficiencies

a) Radiation use efficiency (RUE) is the mass of dry matter (DM) fixed per unit radiation intercepted by leaves.

$$RUE = aC/R_i$$

where *a* is mass of DM gained per unit mass CO_2 fixed by photosynthesis

b) Water use efficiency (WUE) is the DM mass gain per unit mass water evaporated from the soil and leaves.

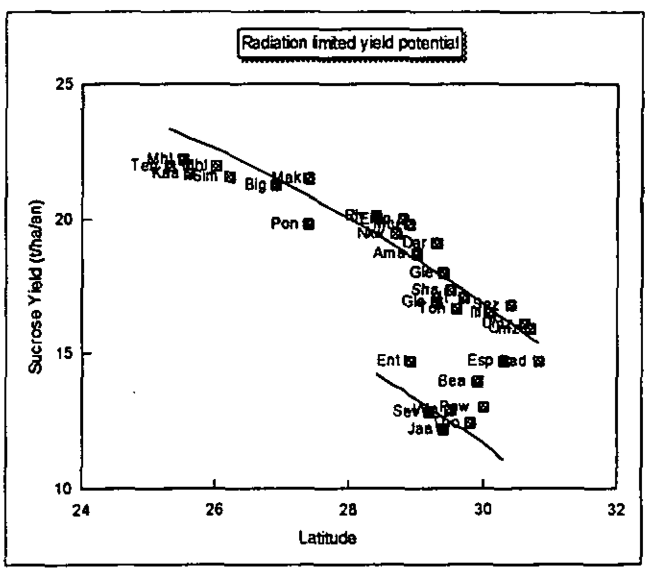
$$WUE = aC/(E_t + E_s) \text{ where } E_s \text{ is soil evaporation}$$

Radiation use efficiency (RUE)

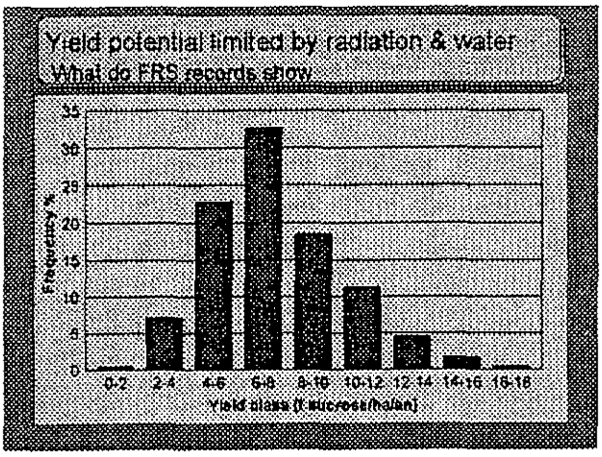
RUE was 1.75 g/MJ for much of the duration of a plant and ratoon crop of the sugarcane variety, Q96 but the average RUE from planting to harvest was 1.37 g/MJ because of reduced biomass accumulation when lodging occurred (Muchow et al, 1994). RUE is not directly comparable with the photosynthetic efficiencies (PE) determined for NCo376 by Thompson (1978) because the proportion of incident radiation intercepted by the canopy was not known. For irrigated crops of NCo376, PE was 0.92 ± 0.03 g per MJ radiation received at the soil and canopy surface. The mean maximum PE determined for irrigated NCo376 after 97 days from planting or ratooning over periods of 55 to 91 days was 1.48 g/MJ and the corresponding mean for H32-8560 (Hawaii) was 1.93 g/MJ (Thompson, 1978). Growth and maintenance respiration was considered in the CANEGRO model (Inman-Bamber, 1991) and when biomass was small the equations in CANEGRO predicted that 1.8 g aerial biomass would result from 1 MJ solar radiation intercepted by the canopy, provided water was not limiting. Recent evidence from research in Australia is that RUE is about 1.7 g/MJ for plant crops and 1.4 g/MJ for ratoon crops. There is no good reason for the difference between these two crop classes but it may have something to do with roots which are ignored in the RUE estimate. Most plant physiologists agree that increases in RUE with breeding will be difficult to achieve and attention should be directed rather towards making the most of the dry matter fixed through photosynthesis.

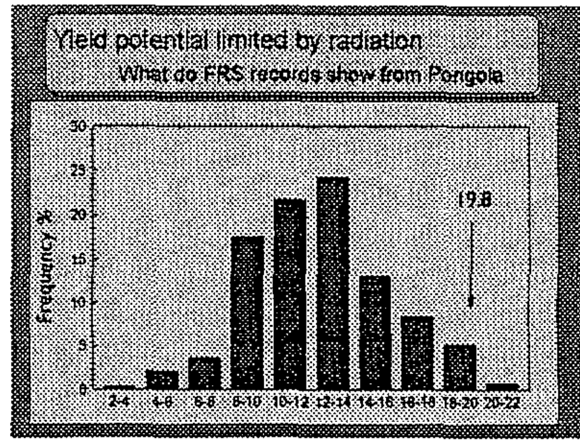
Yield potential

The rationale behind the concept of yield potential is outlined in a 1995 SASTA paper on the subject (Inman-Bamber, 1995). With a radiation use efficiency of about 1.8 g per MJ solar radiation a theoretical maximum biomass yield would be as high as 125 t/ha/an and with a maximum sucrose to biomass ratio (harvest index) of 0.42 the theoretical maximum sucrose yield would be 50 t/ha/an. As we have seen in the past these theoretical potentials are not very useful. We have to be practical and come up with yields that are obtainable with the climate and management system we have inherited and this is what modelling research provided in the SASTA paper. These are more *benchmark* yields than maximum possible yields and they **are** attainable and some growers in rainfed areas are achieving these yields regularly and growers in irrigated areas achieve them occasionally. The figure below is an extract from this paper showing yield potential when water is not limiting and cane is cut annually through the season. Yield potential is not an absolute number because it is subject to management effects on R_i (Radiation interception) and HI amongst other things.



When water is limiting it is probably not difficult to achieve potential yields because one is forgiven for bad husbandry as long as water is not used by weeds or lost as surface runoff. In high rainfall or irrigated areas potential (benchmark) yields are difficult to achieve because other factors (fertiliser, planting etc.) now become limiting. The prospects for increasing productivity with better management without irrigation are therefore not great. Increased industry productivity could be achievd by improved management in the irrigated regions as the figures below suggest. CANEGRO yield potentials were 5.8, 10.2 and 19.8 tons sucrose per ha per annum for rainfed poor and and good soils in Zululand and for the Pongola irrigation scheme respectively.



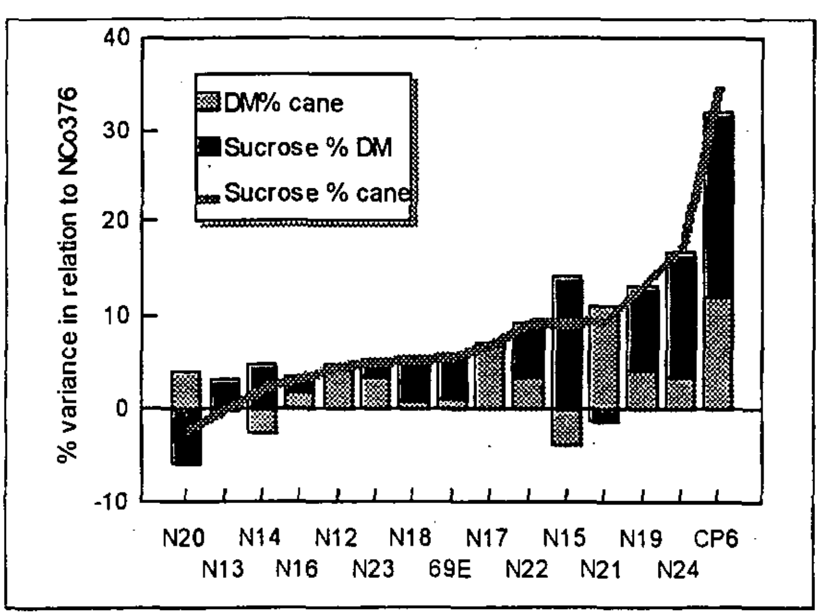


Harvest index and sucrose content

Harvest index (HI) is the efficiency of converting dry matter assimilated by photosynthesis to the saleable products of sugarcane, mainly sugar. The components of HI are 1) purity (sucrose/brix), 2) brix content/dry matter content 3) stalk mass/ above ground biomass. We have a good understanding of the first two components but not much is known about the third.

Varieties

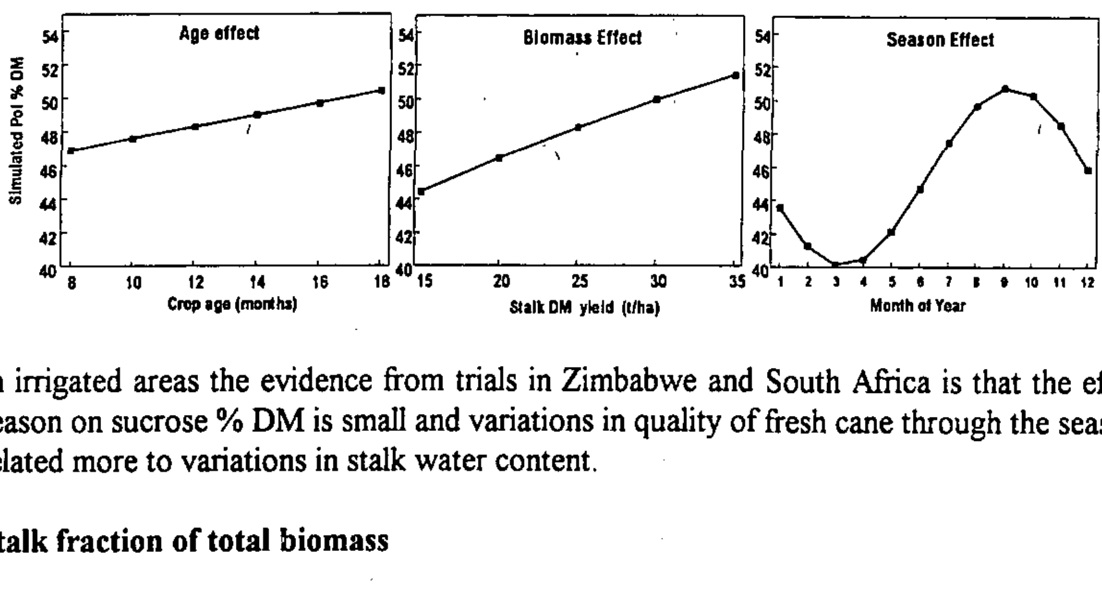
Sucrose % cane (S%) of the varieties tested in RVTs since N12 was released in 1978, varied from -2 to + 35 % of the S% for NCo376 (Figure below). The varieties differed substantially in the way S% depended on dry matter % cane (DM%) and sucrose % DM (S%DM). S% of N17 was 7% greater than that of NCo376 because of increased DM % and S% of N15 was 9 % higher than that of NCo376 because of improved S%DM (Figure below). The large improvement in quality in CP66/1063 depended equally on increased



DM% and S%DM. This variety and others (N15, N19, N24) with considerably enhanced S%DM have the inherent potential of producing greater sucrose yields than NCo376 because they allocate DM more efficiently in the stalks although many other factors may override the performance of these varieties in the field..

Age and Season

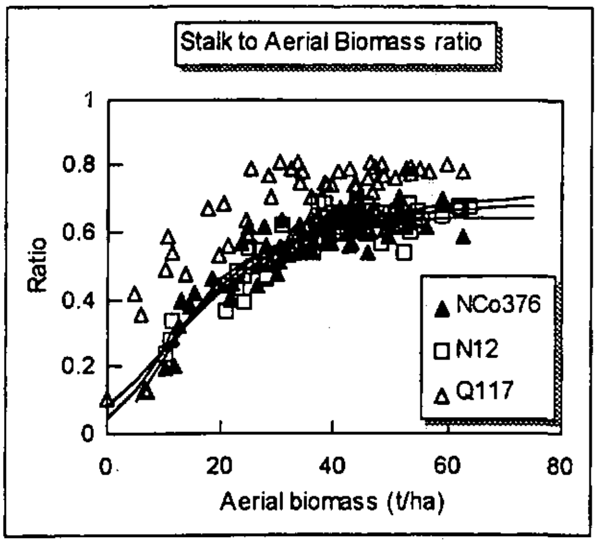
For rainfed NCo376 the partitioning of DM in the stalks is influenced by crop age, crop biomass and season as indicated below. The age effect is not as marked as the biomass and season effect. Using the age and season effects to increase harvest index is complicated by the fact that both factors affect biomass and other crop responses such as eldana susceptiblity. Nevertheless if the industry could produce older and larger crops and concentrate harvesting around the peak sucrose months in rainfed areas there would be efficiency gains in the conversion of dry mass to sucrose.



In irrigated areas the evidence from trials in Zimbabwe and South Africa is that the effect of season on sucrose % DM is small and variations in quality of fresh cane through the season are related more to variations in stalk water content.

Stalk fraction of total biomass

This the third component of HI listed above and it is important to know if we can we manage or breed the crop to improve the fraction of biomass that ends up in stalks that survive until harvest. This component also increases as the crop develops as shown below. At present we do not have much evidence that locally bred varieties differ greatly in this respect.



However a comparison of two SASEX varieties and an Australian variety revealed substantial differences in stalk DM fraction. More biomass was partitioned to stalks of Q117 than to those of NCo376 or N12 (above Figure). Other Australian research indicated that nitrogen also influenced partitioning. The fraction of biomass in stalks was considerably greater when 0 and 50 kg N was applied than when excessive rates were used.

Harvest age

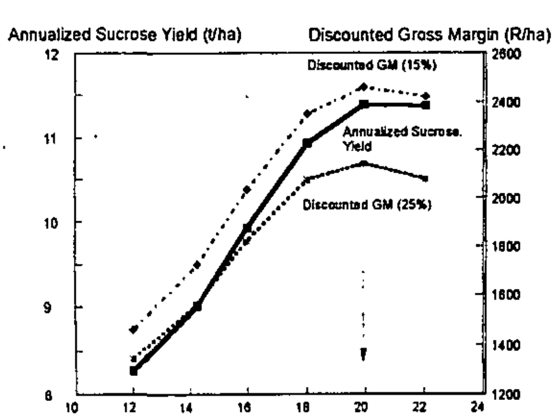
Advantages of increasing harvest age:
1) Increased fractional light interception by leaves
2) Increased allocation of dry matter to sucrose
3) Increased returns on investment in fertiliser and other input requirements.
4) Better water use efficiency because relatively more water in transpired rather than evaporated from the soil

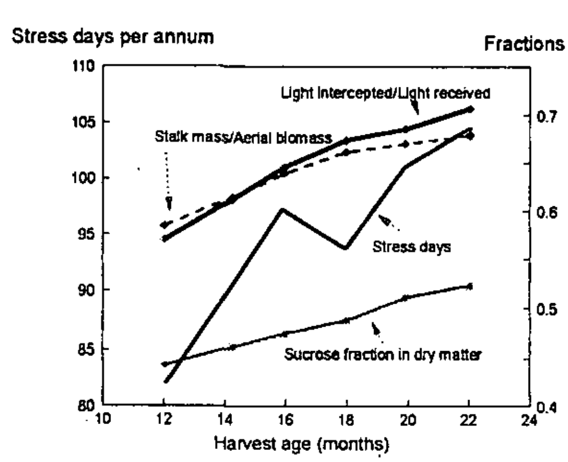
Disadvantages of increasing harvest age:
1) Increased risk of eldana infestation
2) Increased water use
3) Increased lodging

The processes of canopy development, water use, light interception, photosynthesis, respiration and carbon partitioning which are represented in CANEGRO at least at a superficial level are main ones affecting optimum harvest age. Recent research in Australia and South Africa on the growth rate of ageing crops has revealed that stalk death could also play a major role and this process has yet to be defined and quantified for inclusion in CANEGRO. In spite of this deficiency the current version of CANEGRO is still the best tool we have to separate age and season effects and to analyse the effect of harvest age on sucrose accumulation and financial returns.

An example:

The data in the figures below come from simulations of crops growing on the North Coast hinterland on a moderately deep soil (Swartland form). Cognisance was given to the interaction of starting date and harvest age so that the optimum harvest age represents the type of age profile that would be required to achieve the 'average' age. Increasing the harvest age resulted in increases of 1) fractional light interception by the canopy, 2) fraction of sucrose in stalk dry matter and 3) fraction of stalk in aerial biomass. Increased maintenance respiration





and increased water stress are the factors responsible for the inflexion in the sucrose yield curve at about 18 months. The average investment in the crop by way of planting and maintenance costs was assumed to be R1500 per crop. R20 per ton of cane was allowed for harvesting and haulage and a sucrose price of R500 per ton was assumed. In this example the maximum discounted gross margin was achieved at about 20 months which is about 6 months older than the current harvest age in this region. In this hypothetical exercise the cost of harvesting prematurely to avoid eldana damage is therefore about R700 per annum.

Harvest season

We have a particularly long harvest season compared to that of many other industries. Growers generally believe we should have a shorter season and millers generally want a longer one. This is an important and contentious issue and I doubt that anyone in the industry has sufficient data or knowledge of the physiological and management factors to be prescriptive about the matter.

These are some of the physiological factors to consider:

1. Cane quality is usually best in August and September and this is due to higher juice purity and lower stalk water content and higher sucrose fraction in stalk dry matter in rainfed areas.

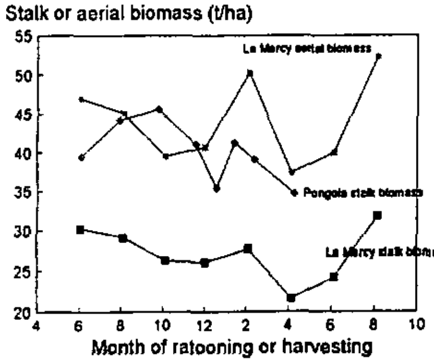
2. Crops starting (from plant or ratoon) shortly before cold and possibly dry winters grow slowly and waste solar radiation

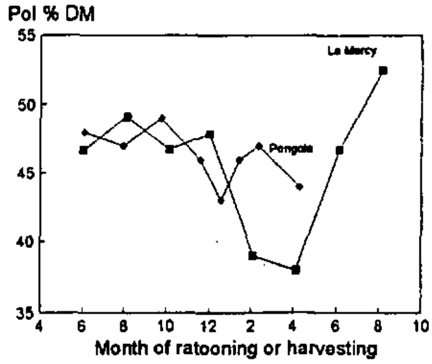
3. Conversely crops starting shortly before or during hot and wet conditions grow rapidly and waste little radiation.

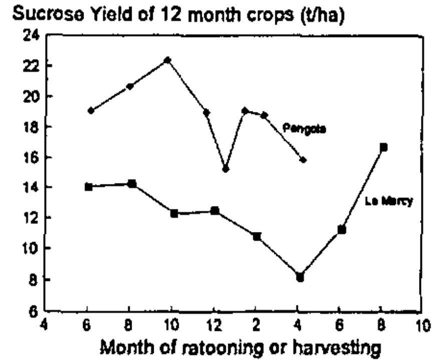
4. More water is required for crops that intercept more radiation (those starting in summer) than those starting in winter

5. Response to ripener is greatest when stalk growth rate is rapid at the extremes of the milling season.

The figures below show biomass and sucrose yields of 12 month ratoon crops of NCo376 in experiments at Pongola under irrigation and at La Mercy without irrigation. These crops were ratooned at different times of the year including the off-crop period. At both sites the April crop produced lowest biomass and lowest sucrose yields at 12 months. At La Mercy, % radiation interception was measured and this was lowest (61 %) for the April crop and highest (82 %) for the February crop. If water was not limiting in the La Mercy experiment we







would expect the February crop to have produced the most biomass at 12 months. Water *was* limiting at times and the second August crop produced more biomass. The advantage of high radiation interception was reduced when stalk biomass and sucrose yield was considered. The highest yields at Pongola were obtained by crops ratooned and harvested in August and October. This of course is when cane quality was highest but not because pol % dry matter was particularly high which is the relevant measure of DM partitioning in this analysis. The declining sucrose yields from June to April in the La Mercy experiment should not taken too seriously because variations in rainfall make generalisations from these data unreliable. These large experiments did not produce clear answers about optimum season length and timing and more knowledge of the physiological processes involved is required to make better sense of these data.

More knowledge of these complex climate-plant interactions should lead to better efficiencies in radiation interception, water use and partitioning to sucrose through better choices of::

1) Mill season length and timing
2) Varieties and harvest schedules
3) Ripeners
4) Drying-off procedures

Dealing with risk

Field experiments conducted by SASEX have dealt with comparisons of various management options available to growers and the basic idea was to determine yield responses (with associated costs sometimes) and to make a safe recommendation for an average condition. The intrinsic principle (I think) was to avoid or ignore risk. For example, a) irrigation recommendations were safely in excess of crop requirements and b) we recommended cutting cane prematurely to avoid eldana. We used average responses to treatments such as trashing (9 t cane/ha/crop ?) when experimental results showed that in some years there was no response and sometimes there was a large response (the average may never have been measured experimentally). We need to develop technology that will allow us to determine the probability of achieving a small or a large response. There are three requirements for this:

a) An understanding of the processes that produced the observed treatment responses.
b) A model (however simple) of the processes.
c) Application of the model to the random climatic variables that are likely to be experienced on the field or farm.

This will allow us to compare options on the basis of cost/benefit as well as risk.
Management options that could be considered for review on the basis or risk and benefit:

1) Trashing
2) Row spacing
3) Irrigation
4) Ridging
5) Harvest age
6) Harvest season
7) Plough-out frequency

References

Inman-Bamber, N.G., 1991. Some physiological factors affecting the optimum age and season for harvesting sugar-cane. *Proc. S. Afr. Sug. Technol.,ass.*,65, 103-108.

Inman-Bamber, N.G.,1995. Climate and water as constraints to production in the south African Sugar Industry. *Proc. S. Afr. Sug. Technol.,Ass.*,69, 55 - 59.

Muchow, RC, Spillman, MF, Wood, AW and Thomas, MR (1994). Radiation interception and biomass accumulation in a sugarcane crop grown under irrigated tropical conditions. Aust J Agric Res 45: 37-49.

Thompson, GD (1978). The production of biomass by sugarcane Proc S Afr Sug Technol Ass 52: 180-187.

THE SOUTH AFRICAN SUGAR INDUSTRIES AGRONOMIST ASSOCIATION

"THE ROLE OF THE AGRONOMIST - AN MCP PERSPECTIVE"

D.H. Carter-Brown
Illovo Sugar Limited

The Agronomist has for many years been an active member of staff on most of Illovo's larger Sugar Estates. The role of the Estate Agronomist has varied over the years in line with the changes that have evolved in our Company and the Sugar Industry. Currently the South African Sugar Industry is again undergoing major changes and it can be expected that the role of the Estate Agronomist must now also change.

THE CURRENT AND RECENT PAST ROLE OF THE ESTATE AGRONOMIST

Until recently Illovo's Miller-cum-Planter [MCP] were an integral part of the Sugar Mill and were regarded as "the supplier of last resort". It was the objective of the MCP's to supply our Mills with as much good quality cane as possible at the lowest possible cost. This objective lead to :

- Large sections [farms] producing between 40 000 - 100 000 tons of cane under one Farm Manager.
- A uniform management structure and philosophy across all Sections and Estates.
- In-house technical expertise to sustain and improve production and efficiencies.

During the 1980's and early 1990's a transformation of the Estates management structure and style took place in that the delegation of authority was pushed downwards and clear areas of authority were created. During the same period the profitability of cane farming on a unit basis began to decline and the dual quota system was introduced. The effects of this were felt more on our MCP farms where high B-Pool quota ratios existed due to the purchase of farms by the Company owing to the "raiding of cane farms" by the larger Timber Companies. As a result business acumen was increased across all levels of Estate Management to sustain profits and cost saving and tight budget controls became the norm.

In addition to these changes Eldana was also having a significant negative effect on cane production. The Estate Agronomist now found himself in a different role to his predecessors and in line with these changes his title became "Estate Management Agronomist".

Firstly he was now working in an environment where Management and fiscal skills were required and recognition [which would lead to promotion and a higher salary] was being given to those who displayed sound management skills. Secondly due to the changes in the Sugar Industry "environment", Applied Technology available to him could be categorised as follows :

- Cost saving technology
- Corrective technology
- Productive technology

Of these three categories applied research was concentrating mainly on the first two elements - cost saving and corrective technology.

Based on these circumstances the Management Agronomists adopted the following role :

- They became custodians of the fertiliser budgets. They cajoled Farm Managers to blend mixes on their farms and to monitor application rates down to the last bag. It was here where they could make significant savings for the Company and contribute positively to the overall objective of tight budget control.
- Tried and trusted herbicide/weed control programmes were written into "policy". "Experimentation always has a risk factor which costs money"!
- A close working relationship developed between the Agronomist and the Farm Manager. In this way both of them shared in the rewards and disappointments of farm management.
- Varieties were introduced primarily to combat Eldana and Mosaic. Short term solutions were being sought to combat problems which were putting tremendous financial strain on the business.
- The Agronomist played an active role on the local Pest and Disease Committees. He was responsible for ensuring that the Estate adhered to the legislation of this and other authorities.

In essence the Agronomist was operating more as a Manager than as a Technocrat. His role was to help keep the "ship afloat" rather than "chart tomorrow's course".

This modus operandi was right for the time. Today though dramatic changes are again taking place throughout the spectrum of the Sugar Industry and it is necessary to review the future role of the Estate Agronomist.

THE FUTURE ROLE OF THE ESTATE AGRONOMIST

It is difficult to predict what the current and future changes within the South African Sugar Industry will have on Illovo's MCP. It is very clear though that world market forces will play a far bigger part than in the semi-protected and controlled Industry of the past. Survival in the future will depend on reading the markets correctly and meeting these demands. It is in this that the future Estate Agronomist will play an active role.

- **Production** - As already mentioned in the case of Illovo's MCP's our current B-Pool ratios are high. In the short term the switch to a single marketing sucrose formula will be advantageous to Illovo. In this sphere the Agronomist will play an active role in boosting production. Fertiliser application rates will need to be reviewed as well as the optimisation of cutting cycles which of late have been designed very much in terms of Eldana control with little significance to maximising production.

  In the longer term production standards will be measured against world norms and it is the Agronomist that will have to spearhead the drive on our behalf to obtain varieties that will maintain our world competitiveness. A key area will be the conversion of technical research into farming practise. The Agronomist will play a crucial role between the Researchers Extension staff and our Farm Managers to ensure that the right technology is used effectively.

- **Strategic Planning** - As with most major Companies in South Africa, Illovo Sugar Limited has reorganised to meet the challenges of the future. The traditional MCP's no longer exist and instead Illovo now has an Agricultural division independent of Illovo's seven Sugar Mills. The strategic alignment of this business needs to be constantly reviewed against past performances, current trends and future assumptions. The key to our business is cane production and thus it is the

Agronomist who will play a leading role in this facet of our business.

- **Customer Focus** - The new dispensation of the Sugar Industry is leading us to a truer customer supplier relationship with the Sugar Mills. The adage goes that the "Customer is always right" and we as suppliers will have to meet the demands of our customer, the Mills.

  Cane quality will become a major issue but as time evolves other components of sugar cane may become pertinent such as fibre quality and quantity, the non-pol ingredients of cane or even the "shelf life" of harvested cane.

  The Estate Agronomist will need to create a close strategic working relationship with the Mill staff ensuring that the product his peers produce meets with current and future requirements of the customer. Due to the in-house Company relationship between our farms and their Mills, experimentation with other sugar producing crops such as sugar beet are already in progress and future joint ventures of this nature will continue.

- **Finance** - The free market environment the Sugar Industry is heading towards will mean that our farming operations will have to run on true business principles. The Agronomist will have to forge a strong working relationship with our Agricultural financial staff. Any new proposal put forward by the Agronomist will have to pass the required financial hurdles before being implemented.

  In the short term, the Agronomist will be required to evaluate, in financial terms, many of our standard farming practices. For example : Is the sound agronomic practise of replanting 10% of ones farm every year a sound economic practice? Does the productive improvement of the new variety outweigh the cost of replanting?

- **People Development** - As with most large Companies, Illovo Sugar Limited is committed to Affirmative Action and the upliftment of our predominantly Black staff. Most of our Black Farm Managers are excellent people managers but lack technical education. It is the Agronomist's role to transfer technical information into practise. He acts as the "go-between" between the Researcher and the Farm Managers. To be successful, the Agronomist will have to ensure that his customer, the Farm Manager, has a full understanding of what is required.

The philosophy of "Do what I tell you and don't ask questions" is a short term one and soon fails. What is required is a steady upliftment programme where the Farm Manager is made fully aware of why he is doing something, what results he should expect from his actions and how he will be able to measure these results. The Agronomist will have to develop skills of his own to enable him to be effective in a Management environment which has low technical skills.

- **Technical** - Considering the future skills profile of our Agricultural operation, one will see a growth in financial skills and staff. On the other hand the agronomic skills of the Farm Managers will probably decline. To counter this shift within the business the Agronomist must remain a true technocrat and not become involved in management. The success of the business will be through productive growth and this cannot be achieved without the best technical inputs.

It can be concluded that the Agronomy function on our Estates will be more crucial in the years to come than in the past. A sound technical background, visionary skills and an ability to gather and disseminate technical knowledge effectively will be the key ingredients of the future Agronomist.

GM\107.rep/ph 19 November 1996

SOUTH AFRICAN SUGAR INDUSTRY AGRONOMISTS' ASSOCIATION

SUGAR YIELDS AND CHEMICAL RIPENING

by RA Donaldson

A data base of chemical ripening experiments done on the farms of the Experiment Station of South African Sugar Association is being created. The data base provides a record of responses under a range of conditions and may be used to indicate trends rather than answer specific questions.

The data base at present contains 105 records of Fusilade Super applications for which there are yield data i.e. cane in plots was harvested and weighed. Treatments in experiments are replicated four to seven times and are compared with unsprayed controls. Most of the experiments were conducted at the Pongola Field Station where cane is grown in a deep structured Hutton sandy clay (Hutton/Stella). The estimated TAM is 464 mm and 61 mm of water is applied every 25 days when water is available. The comparisons therefore are usually made between irrigated chemically ripened cane and irrigated cane.

In this exercise data from experiments in which responses to Fusilade Super were adversely affected by known factors are systematically eliminated from the initial 105 records. The order in which the factors are addressed is the sequence in which they were researched. At any particular elimination step factors which are considered later may be eliminated before the factor is addressed e.g. experiments testing high rates may also have been affected by lodging. Therefore when lodging is considered only the balance of data affected by lodging is eliminated.

The means of all data from experiments conducted between 1981 and 1995 is the basis of the analysis. Because Fusilade Super may reduce monosaccharides and fibre in sugarcane stalks responses are expressed in sugar yields (rather than sucrose) derived from the formula for estimated recoverable sucrose.

All data

The average responses to Fusilade Super when all data are included is an increase in sugar yield of 0.752 $\pm$ 0.097 tons per hectare. This is achieved by increasing the sugar content by 0.855 $\pm$ 0.072 units of ers % cane and by reducing cane yields by 2.914 $\pm$ 0.578 tons per hectare (Table 1).

Eliminating low rates

Rates below 300 mL per hectare were shown to be less effective during the initial screening before Fusilade Super was registered. Eliminating these reduced the records to 92 data sets and raised the average sugar yield response to 0.829 $\pm$ 0.133 tons per hectare, mainly by increasing the sugar content.

Table 1 : Responses and standard errors (SE$\pm$) of yield characteristics, numbers of treatments (n) and probability (prob) of recovering costs after eliminating factors which influence responses to Fusilade Super.

DATA	ERS t/ha	SE$\pm$	CANE t/ha	SE$\pm$	ers %cane	SE$\pm$	n	Prob. 0.2t
ALL	0.752	0.097	-2.91	0.578	0.855	0.072	105	.695
EXCLUDING LOW RATES	0.829	0.133	-3.11	0.769	0.943	0.097	92	.685
> 65 DAYS	0.739	0.161	-3.45	0.898	0.921	0.117	71	.634
> 450 mL	0.787	0.170	-2.98	0.928	0.895	0.123	64	.656
DRY	0.803	0.171	-3.11	0.927	0.912	0.123	63	.667
LODGED	0.836	0.184	-4.28	0.941	1.042	0.125	52	.673
N14<400 mL	0.818	0.202	-4.52	0.944	1.05	0.125	50	.680
ADDING > 65 DAYS	0.970	0.181	-4.00	0.920	1.116	0.110	61	.721
EXCLUDING LATE SEASON	1.207	0.181	-2.84	0.946	1.130	0.124	52	.827

Long intervals between spraying and harvesting

The interval between spraying and harvesting varies from five weeks to nine weeks to accommodate differences in growth rates of autumn (April/May) and winter harvested cane (June/July). Data from experiments with an interval longer than 65 days were eliminated. This reduced the average sugar yield response to 0.739 $\pm$ 0.161 tons per hectare and surprisingly, cane yields were reduced still further. It may therefore be necessary to analyse this factor in more detail e.g. expressing the interval in terms of heat units and if necessary adjust the recommendations. Data from these experiments will be added back to the data sets after considering several other factors.

High rates

Eliminating rates above 450 mL per hectare raised the average sugar yield response to 0.787 $\pm$ 0.170 tons per hectare. As may have been expected cane yields were less severely affected and sucrose content was lowered.

Stressed cane

Mild to moderate stress is known to affect the action of Fusilade Super. Only one set of data of an experiment in which moderate to severe stress was a factor remained for elimination. This brought sugar yield response up to 0.803 $\pm$ 0.171 tons per hectare.

Lodged cane

The rule of thumb is that lodging reduces responses by 50% and that lodged cane should only be sprayed once it has turned up. Eleven sets of data were eliminated because of lodging at this point. Sugar yield response was raised to 0.836 $\pm$ 0.184 tons per hectare with an increase in sugar content and a substantial reduction in cane yields.

Low rates and N14

A higher rate of Fusilade Super is recommended for N14. Data from treatments of less than 400 mL per hectare, of which there were only two remaining, were eliminated in this step. This lowered the average sugar yield response slightly to 0.818 $\pm$ 0.202 tons per hectare due mainly to a slightly reduced cane yield.

Adding long intervals

The data of the experiments harvested more than 65 days after spraying the ripener were added back into the records in this step. This raised the sugar yield response substantially (0.97 $\pm$ 0.181 tons per hectare) by lessening the negative effect on cane yields and raising the sugar content response by 1.116 $\pm$ 0.11 ers units.

Excluding late season data

The conditions, particularly soil moisture and temperature, during the final months of the milling season are very different to those during the early part of the milling season. Because there is limited opportunity for using chemical ripeners when mills close in December spraying is often done before cane has clearly resumed vigorous growth, mostly with poor results. Eliminating late season data improved the average sugar yield response to 1.207 $\pm$ 0.181. The most marked change at this step was the lessening of the adverse effect of Fusilade Super on cane yields.

Costs and value to industry in 1996

By 2 June 1996 an area of 28 134 hectares had been sprayed by commercial aircraft during the current milling season. An unknown area had been sprayed by hand booms microlights and mistblowers and a further 8 000 hectares was planned for late commercial spraying in Mpumalanga. The commercially applied area included 11 635 hectares of irrigated or high yielding cane and 16 539 hectares in areas where not much cane is irrigated. The cost of spraying one hectare was R 80 (Fusilade Super included). Adding R 60 to this to cover other costs like marking field etc. gives one a breakeven response of 0.2 tons sugar per hectare (based on the July 'B pool' price of R 697 per ton). The probability of achieving the breakeven 0.2 tons per hectare is shown in the last column of Table 1. If all the recommendations of the Experiment Station of the South African Sugar Industry are followed the estimated probability of making a positive return from using Fusilade Super is 83%.

If the average 1.207 tons sugar per hectare response for irrigated high yielding cane and a 33% lower response for dryland cane (0.8 tons) is accepted the following estimates can be made assuming the only chemical used was Fusilade Super:

(a) Irrigated cane
11 635 ha x 1.2 = 13 962 tons
R 697 - R 140 = R 557 ('B pool' price - costs) per ton
13 962 x R 557 = R 7 776 834

(b) Dryland cane
16 539 ha x 0.8 = 13 231 tons
R 697 - R 140 = R 557
13 231 x R 557 = R 7 369 778

Total gain = R 15 146 612
Total cost = R 3 807 020

Can we do better ?

From 1991 to 1995 an experiment was repeated every year to compare the responses of four varieties to Fusilade Super, ethephon (Ethrel) and the combination (ethephon followed by Fusilade Super). The accumulated sucrose yields over four years of untreated cane (control) and additional sucrose yields from spraying ripeners are shown in Table 2.

Table 2: Accumulated sucrose yields and responses (t/ha) over four years for four varieties

Variety	Control	Ethephon	Fusilade S	Combination
N19	54	+1.8	+2.0	+8.4
N22	55	-0.5	+4.1	+5.9
CP66	54	0	+4.7	+3.8
N12	48	+0.6	+9.8	+10.6

These data show the substantial gains that could be made from using the combination treatment particularly on N19. A similar experiment which included NCo376 and N22 showed that NCo376 also responds particularly well to the combination treatment. Gains from this treatment above the single ripeners on N22 and N12 are less dramatic but may still warrant the cost of 'double application'. This was not the case with CP66/1043 and only Fusilade Super is recommended for this variety, N14 and possibly N22.

SOUTH AFRICAN SUGAR INDUSTRY AGRONOMISTS' ASSOCIATION

PRACTICAL MEASURES USED TO MANAGE ELDANA IN SUGARCANE

by GW Leslie

The approaches to the control of pests like eldana can be divided into three categories:

Ecological control options.
These comprise manipulating the crop or the crop environment.

Chemical control options.
These comprise the use of insecticides as well as pheromones.

Biological control options.
These comprise the use or manipulation of natural enemies or diseases.

Our current recommendations are based on ecological and chemical control options and are discussed below.

1 Conducting farm surveys.

By conducting surveys for eldana of your fields, the trends in damage can be seen and action taken. While actual values for damage may be low, a rising trend indicates the potential for more severe damage to occur at a later date and action needs to be considered.

Frequent small surveys are more valuable than a few intensive surveys. Also, while estimating larval numbers is of value, it is the damage that is critical and this should always be measured in a survey. A summary survey form has been prepared (Table 1) which lists eight factors that can influence an eldana infestation. By considering these for each field surveyed, an idea of the hazard in that field can be obtained, particularly when more than one survey is conducted.

Conducting a survey is straight forward. A method is given in the September 94 issue of the LINK. Basically, the field to be surveyed can be divided into a number of equal areas. From each area a number (five, ten or more) stalks are sampled at random. Each stalk is then examined for eldana larvae and damage. The values can then be recorded on the survey form and interpreted along with other information.

Table 1: A survey form as an aid to assessing the eldana hazard in a field.

FACTOR	RATING	SURVEY DATE AND SCORE				
CROP / ENVIRONMENT FACTORS						
VARIETAL FACTOR	5 RESISTANT					
	10 INT.					
	20 SUSCEPTIBLE					
SOIL FACTOR	5 GOOD					
	10 POOR					
WATER FACTOR	5 GOOD					
	10 POOR					
CROP AGE	5 < 5 MONTHS					
	10 6 - 10 MONTHS					
	20 >11 MONTHS					
N APPLICATION	2 LOW					
	4 STANDARD					
	8 HIGH					
	SUB TOTAL					
HAZARD LEVEL:>50						
ELDANA FACTORS						
ELDANA Nos.	5 LOW(<15 /100)					
	10 INT.(16 - 25/100)					
	20 HIGH (>30/100)					
ELDANA DAMAGE(a)	5 LOW (<2%JB)					
	10 INT. (3 - 5%JB)					
	20 HIGH (>10%JB)					
ELDANA DAMAGE(b)	5 LOW (<10%SB)					
	10 INT (11 - 20%SB)					
	20 HIGH (>20%SB)					
	SUB TOTAL (HAZARD LEVEL:>30)					
	GRAND TOTAL (HAZARD LEVEL:>80)					

2 Age at harvest.

Harvesting the crop before severe eldana damage occurs is an effective approach to reducing damage. But, this generally means that a crop will be harvested before it has reached its economic harvest age, resulting in considerable loss (Figure 1). However, harvesting dates may be flexible if considered in conjunction with survey results. If a crop planned to be harvested at a certain date is shown to have lower than expected levels of damage, harvesting may be delayed.

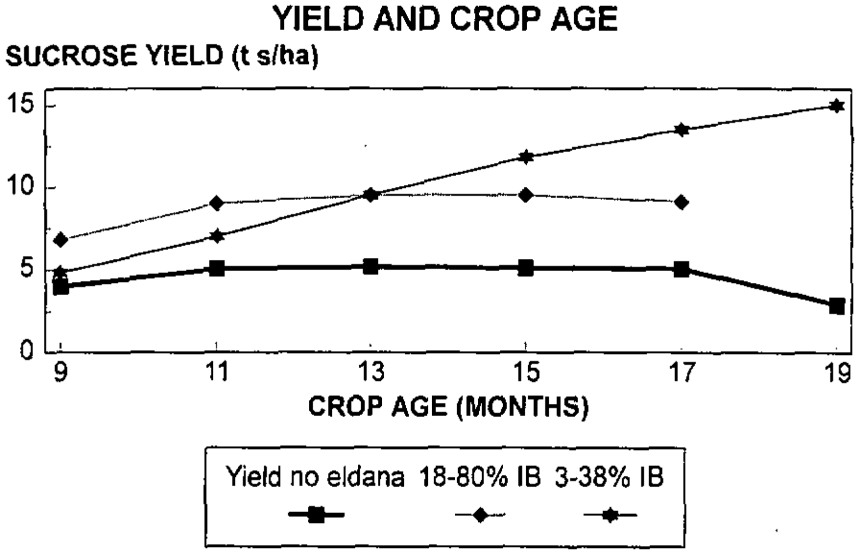


Figure 1: The relationship between sucrose yield and three levels of eldana damage measured as percent. Internodes bored.

3 Varietal susceptibility.

Choice of variety is important. In areas of your farm that are prone to drought stress, plant those varieties that are less susceptible to eldana (for example N21, N12 , N23). If cane is to be carried over, only consider the more resistant varieties for this. Figure 2 ranks commercial varieties according to their susceptibility to eldana.

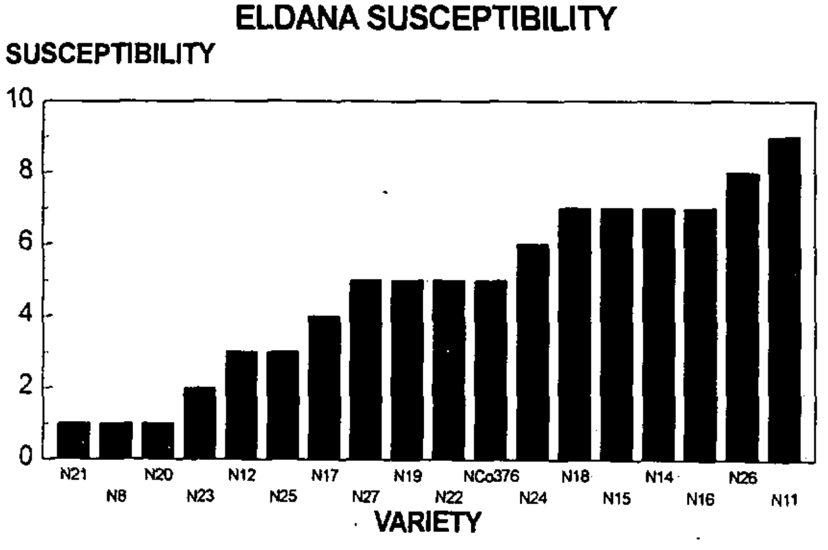


Figure 2: Rating the susceptibility of sugarcane varieties to eldana. (1 resistant, 9 susceptible).

4 Nitrogen fertiliser.

A number of studies have shown the link between levels of nitrogen fertiliser and eldana though the association is poor. As an example of this association the results from Carnegie (1982) are summarised in Figure 3. This study also shows the influence of the N mineralising capacity of the soil.

Phytophagous insects use plant nitrogen for growth and development. The more of this that is available the better such insects survive. Of course nitrogen is required to produce a commercial crop, but a balance must be struck between plant requirements and insect development. The FAS recommendations from SASEX should be followed. Where eldana is a problem the amount of nitrogen applied could be reduced by 20 to 30 kg/ha.

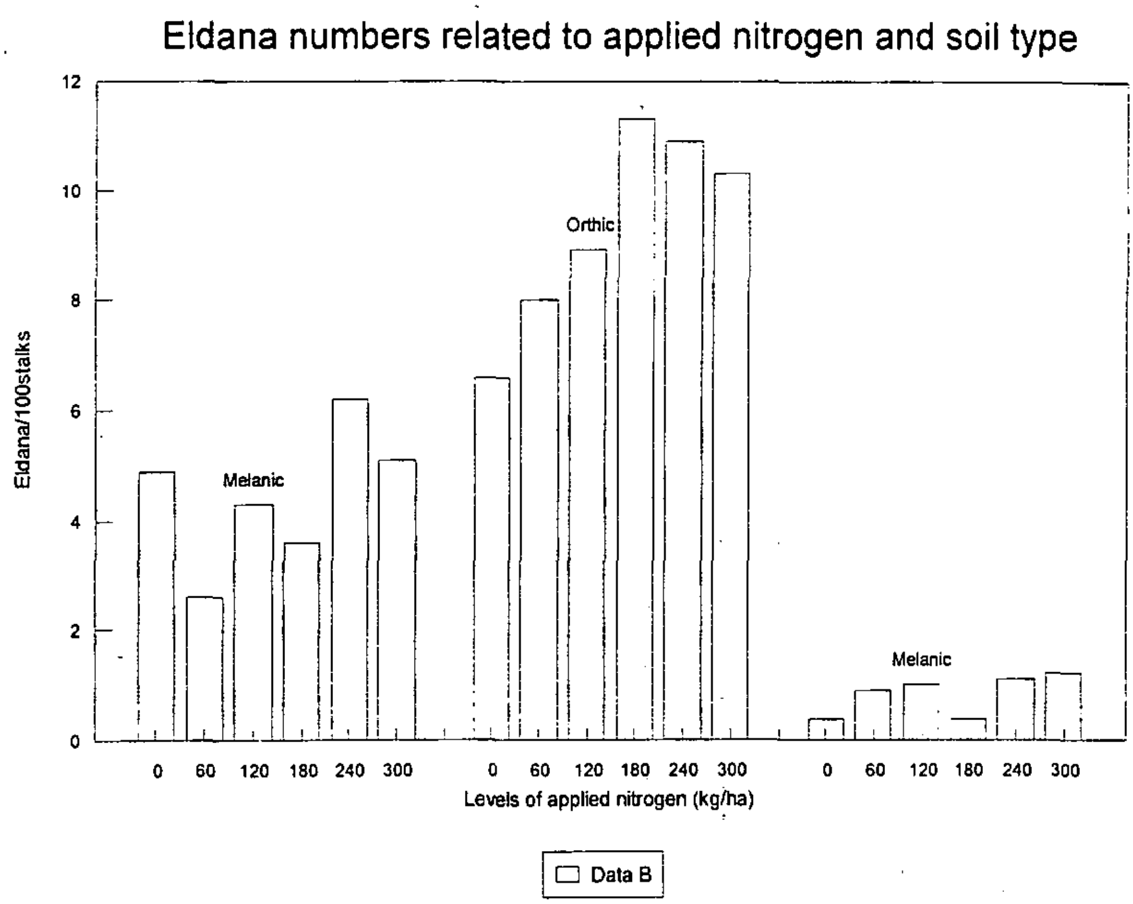


Figure 3: The relationship between applied N, soil type and eldana.

5 Field hygiene.

This is particularly important where the previous crop had high levels of eldana. Whole stalks should be removed and stubble cut as close to the ground as possible. The rationale behind this recommendation is that eldana can survive in the stalk residues left behind after a crop is harvested. The more of such residues that can be removed, the less likely reinfestation will be.

6 Moisture Stress.

Where possible stress induced by too little or too much water must be avoided. Crops grown on shallow soils can be easily stressed and should be harvested earlier than crops on better soils. Also weed competition and poor drainage are factors that can lead to crop stress and these should be addressed.

7 Pre-trashing.

The effect of pre-trashing on eldana infestations has been shown (Carnegie and Smaill 1982). Later work showed that pre-trashing in conjunction with an insecticide reduced damage further (Table 2).

It is assumed that pre-trashing influences oviposition and neonate larval survival. If so then pre-trashing over the period of a moth peak would have the greatest effect on an infestation. Generally moth peaks occur between September and November, depending on the region so pre-trashing in these months should be most effective.

Table 2: The influence of pre-trashing and an insecticide on eldana numbers and damage.

Treatments	Number of eldana/100 stalk			Number of damaged eldana/100 stalk		
	Pre-treatment	1st Post-treatment	2nd Post-treatment	Pre-treatment	1st Post-treatment	2nd Post-treatment
Untrashed control	10.0	11.0	28.2	53.3	57.5	80.7
Pretrashed control	13.3	**7.0** (36)	**20.2** (28)	52.5	**56.5** (2)	78.2 (3)
Pretrashed-insecticide	11.6	**4.6** (58)	**13.3** (53)	50.5	**51.9** (10)	66.3 (18)
Intrashed-insecticide	12.2	6.9 (37)	18.4 (35)	49.2	52.9 (8)	69.6 (14)

8 Seedcane.

The use of seedcane free of eldana, is important for good crop development. The following are suggested options for ensuring that seedcane is of the highest quality.

1. Inspect the cane and, if possible, use only undamaged stalks.
2. Heat treat the cane at 50EC for 30 minutes, or
3. Dip setts in Phoxim (2ml/l) for 15 minutes.

Latest trials suggest that Cypermethrin (3,75ml/l) or Permethrin (1,5ml/l) are effective in killing eldana in setts if immersed for fifteen minutes. These treatments have still to be registered.

It is worthwhile to note that such treatments only kill the larvae, and so reduce the chances of subsequent reinfestation of the crop. If the sett has been severely bored, poor germination may result anyway, despite the treatment.

9 Burning the crop.

Surveys or trials have shown that there is no significant difference in the level of eldana at harvest, between fields trashed or burnt in the previous crop. Interestingly trials also showed that, after harvest, eldana levels did remain lower for longer in the crop previously burnt at harvest, but after about five months, levels of damage rose to those shown in the crops trashed at harvest.

References

Carnegie AJM 1982. Current research programme against Eldana saccharina Walker (Lepidoptera: Pyralidae). SASTA Proc. 56 95-98.

Carnegie, AJM and Smaill, RJ. 1982. Pre-trashing of sugarcane as a means of combating the borer Eldana saccharina Walker.