ESTIMATED ANNUAL BENEFITS REQUIRED PER DOLLAR SPENT ON RESEARCH

Target rate of return = 10%

Years needed for R & D	Expected life of benefits (years)					
	5	10	15	20	25	30
1	0.264	0.163	0.132	0.118	0.110	0.106
2	0.290	0.179	0.145	0.129	0.121	0.117
3	0.319	0.197	0.159	0.142	0.133	0.128
4	0.351	0.217	0.175	0.156	0.147	0.141
5	0.386	0.238	0.193	0.172	0.161	0.155
6	0.425	0.262	0.212	0.189	0.177	0.171
7	0.467	0.288	0.233	0.208	0.195	0.188
8	0.514	0.317	0.256	0.229	0.215	0.207
9	0.566	0.349	0.282	0.252	0.236	0.227
10	0.622	0.383	0.310	0.277	0.260	0.250
15	1.002	0.618	0.499	0.446	0.418	0.403
20	1.613	0.995	0.804	0.718	0.674	0.649

Target rate of return = 15%

Years needed for R & D	Expected life of benefits (years)					
	5	10	15	20	25	30
1	0.298	0.199	0.171	0.160	0.155	0.152
2	0.343	0.229	0.197	0.184	0.178	0.175
3	0.395	0.264	0.226	0.211	0.205	0.201
4	0.454	0.303	0.260	0.243	0.235	0.232
5	0.522	0.349	0.299	0.279	0.271	0.266
6	0.600	0.401	0.344	0.321	0.311	0.306
7	0.690	0.461	0.396	0.370	0.358	0.352
8	0.794	0.530	0.455	0.425	0.412	0.405
9	0.913	0.610	0.523	0.489	0.473	0.466
10	1.049	0.701	0.602	0.562	0.544	0.536
15	2.111	1.410	1.210	1.130	1.095	1.078
20	4.246	2.836	2.434	2.274	2.202	2.168

Target rate of return = 20%

Years needed for R & D	Expected life of benefits (years)					
	5	10	15	20	25	30
1	0.334	0.239	0.214	0.205	0.202	0.201
2	0.401	0.286	0.257	0.246	0.243	0.241
3	0.482	0.344	0.308	0.296	0.291	0.289
4	0.578	0.412	0.370	0.355	0.349	0.347
5	0.693	0.495	0.444	0.426	0.419	0.417
6	0.832	0.594	0.532	0.511	0.503	0.500
7	0.999	0.712	0.639	0.613	0.604	0.600
8	1.198	0.855	0.766	0.736	0.724	0.720
9	1.438	1.026	0.920	0.883	0.869	0.864
10	1.725	1.231	1.104	1.060	1.043	1.036
15	4.293	3.062	2.746	2.637	2.595	2.579
20	10.683	7.620	6.833	6.561	6.457	6.417

SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION

LAND PREPARATION

Phil Landrey

Land preparation only contributes 4% of the total cost of sugarcane production. It is therefore of much greater importance to choose a land preparation system which will ensure best germination of a healthy crop; rather than the cheapest possible operation. A saving in land preparation cost will only have a marginal effect on total cost, but an inferior system may lead to lower yields and fewer ratoons which would have much more serious cost consequences.

The main objectives in land preparation are assumed to be:

- to effectively destroy the old crop
- to prepare a seedbed for planting

1. Traditional system:

Operation	Cost* (R/ha)
Deep plough (disc)	100
Disc harrow	48
Plough	100
Disc harrow	48
Disc harrow (light)	33
Ridger	69
Total	398

2. Conventional tillage system (heavier soils):

Operation	Cost (R/ha)
Shallow (100 mm) mouldboard plough (May)	84
Disc harrow (June)	48
Plough (200-250 mm) mouldboard (August)	84
Disc harrow (150 mm) (August)	48
Ridger	64
Total	333

* For 260 ha under cane, with a 26 ha (10%) replant per year.

3. **Conventional tillage system (sandy soils):**

Operation	Cost (R/ha)
Shallow (100 mm) rotary hoe (May) Disc harrow (100 mm) (June) Disc harrow (150 mm) (August) Ridger	104 33 48 69
Total	254

4. **Minimum tillage system, chemical (heavier soils) - Option 1:**

Operation	Cost (R/ha)
Full cover spray Roundup at 8 ℓ/ha (1 man-day) from November onwards (R25/ℓ) Minimum rotary tiller in interrow at 150 mm (including ridger) (November)	5 200 107
Total	312

5. **Minimum tillage system, chemical (heavier soils) - Option 2:**

Operation	Cost (R/ha)
Full cover spray Roundup at 8 ℓ/ha from November onwards (R25/ℓ) Minimum disc tiller in interrow (including ridger) (November)	5 200 65
Total	270

6. **No-tillage system, chemical (sandy soils):**

Operation	Cost (R/ha)
Full cover spray Roundup at 8 ℓ/ha from September onwards (R25/ℓ) Ridger	5 200 69
Total	274

7. **Reduced tillage system, mechanical (heavier soils) - Option 1:**

Operation	Cost (R/ha)
Shallow (100 mm) mouldboard plough (May) Disc harrow (100 mm) (June) Disc harrow (100 mm (August) Minimum disc tiller with ridger (August)	84 33 33 65
Total	215

8. **Reduced tillage system, mechanical (heavier soils) - Option 2:**

Operation	Cost (R/ha)
Shallow (100 mm) mouldboard plough (May) Disc harrow (100 mm) (June) Disc harrow (100 mm (August) Minimum rotary tiller on row only at 150 mm (August) (including ridger)	84 33 33 107
Total	257

9. **Reduced tillage system, mechanical (heavier soils) - Option 3:**

Operation	Cost (R/ha)
Shallow chisel plough (twisted shovel) (May) Shallow chisel plough (sweeps) (June) Shallow chisel plough (sweeps) (June) Chisel plough (twisted shovel) (August) (including ridger)	36 36 36 36 65
Total	209

10. **Reduced tillage system, manual (sandy soils)**

Operation	Fuel (ℓ/ha)	Man-days /ha	Operation cost (R/ha)
Chipping (May) Ridger	- 12	40 -	200 69
Total	12	40	269

The cheapest systems are therefore:

	For heavy soils:	**Cost/ha**
9	*Reduced tillage with chisel plough and disc minimum tiller*	*209*
7	Reduced tillage with shallow m.b. plough, disc harrow and disc minimum tiller	215
8	Reduced tillage with shallow m.b. plough, disc harrow and rotary minimum tiller	257
5	Minimum tillage, chemical and disc minimum tiller	270
	For lighter soils:	
3	Conventional with rotary hoe	254
10	Manual chipping	269
6	No-tillage with chemical	274

When comparing these costs, the assumptions made in the tables must be critically analysed. An increase in the time required for any mechanical operation, or in the price of chemicals or a reduction of the chemical application rate will change these costs.

More important is to note that there is not a vast difference in cost between the systems and the grower should choose the system best suited to his requirements, considering factors such as:

- successful eradication of old crop
- acceptable seedbed
- soil and moisture conservation
- time of year best suited to other farming operations
- total machinery complement

AGdeB/MG
22 October, 1986

SEEDCANE

Arthur Eggers.
Stan Rau

by

N. Polkinghorne

ASPECTS TO BE COVERED INCLUDE:

- The historic attitude of growers with regard to seedcane
- Various methods of seedcane production
- The Amatikulu seedcane scheme
- The financial implications of seedcane in the production of sugarcane.

SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION

A PRACTICAL METHOD OF EVALUATING VARIETIES

By A Stead

INTRODUCTION

Over the past 20 years, the South African Sugar Association Experiment Station has released a new variety almost every year, each having its own strengths and weaknesses. If the wide range in soil types, climate, disease and pest situations is taken into account, it can be seen that the task of selecting the most profitable variety has become more difficult. Each variety's performance has been carefully documented but the importance to the sugarcane grower of each characteristic is often either overlooked or subject to personal prejudice. By establishing a value for the most important characteristics, and combining them into a score for each variety, enables the grower to select the variety which is most likely to be an economic success under his environmental situation.

METHOD

The characteristics which are to be considered are divided into two categories. Firstly, those that vary with locality, such as yield of sucrose per hectare, expected ratoon life, disease reactions and susceptibility to eldana, and secondly, those that remain more or less constant irrespective of where the variety is grown. Examples of the second category are sucrose % cane, fibre content, purity, payload, herbicide tolerance, ability to canopy quickly, lodging resistance and drought resistance.

Monetary terms have been used as a common denominator for expressing the ratings for the various factors as this seemed the most appropriate and easiest method to apply and understand.

Trial results have been used in preference to commercial ratings as the influence of unconsidered variables should be kept to a minimum, but not all the required information is available from the trial results. Therefore, a calculated guess has been made, based on the opinions and experience of people who are knowledgeable on the subject.

The amount of sucrose a variety produces is the single most important characteristic and it is a measure of a variety's worth. To obtain a yield value, the variety trial results have been expressed as a percentage of the standard variety NCo376. Trial results reflect an unusually high standard of management to eliminate as many unforeseen factors as possible. To derive a realistic commercial yield, the variety trial ratings were applied to good commercial yield values for the conditions under examination. All the other varietal characteristics involve some form of cost to the grower and should therefore be subtracted from the basic income.

By completing this exercise one gains an appreciation of the worth of the various varietal characteristics. It enables the grower to confirm that all the important factors have been appraised and that the choice of variety is the best that can be made using the available information for his environmental conditions.

SCORES FOR COMPARING VARIETIES

COASTAL SHALE (R260 ton,Trans R5 ton,Smut 0%)

Factor	Standard	NCO376	N55/805	N7	N12	N13	N14	N16	N17	N18
		Agronomic Scores(devns from Standard)								
Yield	2763	0	-138	0	359	304	-83	28	249	0
Ratoon	-238	0	-119	0	0	-48	-119	-48	0	-119
Transp(su)	-425	0	45	17	-18	-37	-10	33	2	37
(pload)	0	0	0	0	0	0	0	0	0	0
Drought	-104	0	83	52	104	52	-21	52	83	52
Herb.	0	0	0	-55	0	-61	-54	0	0	-83
Canopy	-37	0	37	-18	-5	37	37	37	-13	0
Lodging	0	0	0	0	0	0	0	0	0	0
Quality	0	0	0	0	0	0	0	0	0	0
TOTAL	1959	0	-92	-5	441	247	-249	102	321	-113
		Disease/pest scores(devns from Std)								
RSD	-134	0	110	29	15	-15	4	28	19	29
Smut	0	0	0	0	0	0	0	0	0	0
Mosaic	0	0	0	0	0	0	0	0	0	0
Rust	0	0	0	0	0	0	0	0	0	0
Eldana	-332	0	1	93	73	-73	-135	-181	126	-60
Total	-465	0	111	121	88	-88	-131	-153	145	-31
			Overall Score							
Total	1494	0	19	117	529	159	-380	-51	465	-144
			5	4	1	3	8	6	2	7

SCORES FOR COMPARING VARIETIES

COASTAL SHALE(R160 ton,Transp R8 ton,Smut 2%)

Factor	Standard	NCO376	N55/805	N7	N12	N13	N14	N16	N17	N18
	Agronomic Scores(devns from Standard)									
Yield	1700	0	-85	0	221	187	-51	17	153	0
Ratoon	-223	0	-112	0	0	-45	-112	-45	0	-112
Transp(su	-680	0	69	25	-34	-61	-12	48	-2	54
(pload	0	0	0	0	0	0	0	0	0	0
Drought	-64	0	51	32	64	32	-13	32	51	32
Herb.	0	0	0	-34	0	-38	-33	0	0	-51
Canopy	-23	0	23	-11	-3	23	23	23	-8	0
Lodging	0	0	0	0	0	0	0	0	0	0
Quality	0	0	0	0	0	0	0	0	0	0
TOTAL	710	0	-54	12	249	99	-198	75	194	-76
	Disease/pest scores(devns from Std)									
RSD	-82	0	68	18	9	-9	20	17	12	18
Smut	-129	0	-27	-35	-17	-53	123	-1	129	123
Mosaic	0	0	0	0	0	0	0	0	0	0
Rust	0	0	0	0	0	0	0	0	0	0
Eldana	-204	0	1	57	45	-45	-83	-111	77	-37
Total	-415	0	41	39	37	-107	60	-96	218	104
			Overall Score							
Total	295	0	-12	51	286	-9	-138	-21	412	28
			6	3	2	5	8	7	1	4

COSTS OF FERTILIZER POLICY AT SEZELA

By M.F.A. Leclezio

Toni Wood

1. Background

2. Fertilizer costs

3. Ways of controlling / reducing costs.

   3.1 Management — labour driven - decentralised.

   (a) Productivity
   (b) Purchasing
   (c) Handling - bulk vs bag - save R10-R12 /ton fert used

   3.2 Technical Advances

   (a) Application Techniques — Results of placement trials? See Toni Wood's talk.

   i) Hand Application
   ii) The Sezela Wheel
   iii) The Mayfield Fertilizer Applicator

   (b) Methodology and frequency of soil and leaf sampling.

   (c) Recording system

4. Overall impact of fertilizer policy on profits.

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS ASSOCIATION

THE ECONOMIC OPTIMISATION OF WEED CONTROL

by

ROD ADENDORFF Steve Coster

All fertilisers do for the weedy farmer is grow him bigger weeds.

A WHY DO WE CONTROL WEEDS?

1. To improve profits.

2. Prevent loss of yields.

3. Cane Cutter Productivity is improved.

4. Total Labour Productivity is improved.

B WHY ARE WEED CONTROL PROGRAMMES EXPENSIVE?

1. Incorrect herbicides are selected.

2. Incorrect capacity and timing. requires to spray 3% of total area in one day.

3. Preference for post-emergence treatments.

C HOW TO GET ON TOP AND STAY ON TOP OF WEEDS.

1. TIMING:
   One must get timing correct so as to control weeds
   at correct weather conditions
   at correct stage of weed growth
   at correct stage of cane growth

2. TRAINING:
   Labour must be trained so as to have a better understanding of their task and weed control.

3. WEED SPECTRUM:
   Identify weeds field by field in order to know your problem.

4. HERBICIDES:
   Select according to weed spectrum field by field.
   Be specific, dont generalise.

5. FOLLOW UP:
   Hand weeding must fit in with your chemical programme so as not to allow seeding.

CONCLUSION

1. Get serious about your weed control programme.
2. Make sure you have the capacity to get your timing right.
3. Accept that prevention is better than cure or pre-emergence is better than post-emergence.
4. Use the correct herbicide for the correct weeds at the correct time.
5. Be sure not to miss your follow-up hand weed.
6. Plan your programme.
7. Organise your spray gangs.
8. Motivate your workers.
9. Control results, not activities.
10. Be pro-active and not re-active.

SOUTH AFRICAN SUGAR ASSOCIATION

AGRONOMISTS ASSOCIATION

Ken Fell

Ray Donaldson

The use of Nematicides in relation to the economic optimisation of Agricultural practices under the current economic climate.

If one looks at the table prepared by the Experiment Station in Appendix 1, one sees that the percentage costs for Nematicides in proportion to total cane growing costs are only 0,5% for plant and 0,5% for Ratoon crops. 1% of the total expenditure. Why then focus on Nematicide costs when they contribute apparently so little to the total farm costs? For two reasons a) because Nematicides as such appear to be a nebulous subject and sometimes a visual benefit is so hard to see it is often one of the first areas where people look for cost saving and b) on weak sands it is often the difference, for a comparatively small cost, between economic and uneconomic yields.

How then do we make the decision whether to use Nematicides or not, and which Nematicide do we use bearing in mind the discrepancy in price between products?

In order to address this subject it is intended to go through the processes that were used for decision making for Tongaat-Hulett Sugar. Unfortunately, because of confidentiality, specific product prices can't be used, but the principles will still apply.

Cont. / Page 2 ...

In theory the decision is simple. All one needs is a yield response to give additional revenue from which one subtracts marginal costs (harvesting and transport are used here only, although other benefits such as reduced weed control cost because of earlier canopy, longer ratoons etc. can also be taken into account). The difference between the two result in the amount available for Nematicides. If the Nematicide cost results in a nett profit the decision is easy. The more profitable product is the obvious product to go for. Straight forward.

Not so. The problem is the variability of response resulting from clay %, weather conditions, time of year, etc. etc.

In order to solve these problems we summarized all the previous trial results from as many sources as possible. Eventually after much analysing, adding, comparing etc. we decided to go with the Experiment Station results as they were reasonably similar to ours and likely to be more unbiased.

Because there are virtually no trial results available for more than 8% clay and to limit costs we made the decision, however, to limit application to Clansthal soils with < 8% clay.

The following is the yield response that we used :-

	RESPONSE (t/ha)	
	ALDICARB	CARBOFURAN
Plant Cane	16	13
Ratoon - Fernwood (< 5% clay)	27	12
- Clansthal (> 5% clay)	13	7

Cont. / Page 3 ...

The next step is to estimate the B pool price (assuming an A pool surplus) in 18 months' time discounted to to-day's values.

The price we used for our exercise (B pool + Transport pool + Milling Margin) was R268,32 per ton sucrose which at 12,5% sucrose works out at R33,54 per ton cane.

Our marginal harvesting + transport costs are R7,27 so the marginal profit per ton

R33,54
- 7,27

R26,27 / ton cane

The yield responses can now be tabulated in marginal profit terms

	ALDICARB	CARBOFURAN
Plant Cane	R420,32	R341,51
Ratoon (Fernwood)	R709,29	R315,24
(Clansthal)	R341,51	R183,89

The rest is simple.

If Aldicarb costs about R250,00 per ha and Carbofuran R170,00 the nett situation including cost of product is as follows :-

	ALDICARB	CARBOFURAN
Plant Cane	R170,32	R171,51
Ratoon (Fernwood)	R459,29	R145,24
(Clansthal)	R91,51	R13,89

Cont. / Page 4 ...

The tabulated results above show that for Ratoons, using the figures that we have used, Aldicarb gives us the most profit, on average, per ha. In plant cane the profitability is about equal.

Because of the current economic climate the next subject that should be addressed is the question of restrictions. If restrictions were to be applied should we cut out Nematicide application in order to restrict yield?

A model can be built to answer this question.

Assume a Fernwood field will give you 40 t/ha without Nematicides and 67 t/ha with Nematicides. A profit/ha can be worked out for each situation. In this case B pool prices (as above) will be used, assuming full delivery of A pool quota.

	67 t	40 t
Revenue/ha (R33,54 / t)	R2 247	R1 342
Marginal harvesting and transport (R7,27 / t)	- 487	- 291
Cost of Ratooning (R567 / ha)	- 567	- 567
Assumed cost of Nematicide	- 250	-
Nett profit/(loss)	R 943	R 484

The profit per ton of the first 40 tons is R12,10 and the profitability of the extra 27 tons (R943 - R484)/27 = R17,00 per ton.

Cont. / Page 5 ...

The answer therefore is if Nematicides are looked at in isolation one should rather reduce area than not apply Nematicides.

Perhaps the answer was obvious from the beginning, the model serves merely to illustrate the point.

K FELL
20/10/86

3.4.7

DRAFT

DRAFT

Comments on the paper," Ripeners & related aspects", presented to the 1986 AGM of the SA Sugar Agronomists Association in Durban, November (?) 1986

by

H. Rostron

Unfortunately because I cannot become a member of the Agronomists Association I have only just seen a copy of this paper by RA Donaldson & B Ashburner.

1. My main concern is that the standard management practice assumed to apply to ripened sugarcane is not correct, ie, "High accurately topped ripened and not dried off" (See Table 1). In all but one or two commercial experiments carried out during the past 14 years with all three registered chemical ripeners, the crops have been at, or near field capacity when treated and normal drying off procedures have been followed. Thus, this must be the standard against which any other crop manipulations are compared. With this management practice the mean response to all chemical ripeners is about 1,0 ton ers/ha.

   We do not know what the results would have been if the crops had not been dried off, but we do know that the responses were highly economic, hence the regular use of chemical ripeners in Swaziland, Malelane, Nkwaleni valley and Umfolosi areas.

2. The SASTA paper by Donaldson, from which data was extracted is not identified but I presume that it is the one on moisture stress, nitrogen levels and ripener response, presented at the 1986 SASTA Congress.

   Because the crops in experiments 1,2 and 3 were suffering from moisture stress at the time of treatment (See Figure 1), I do not believe that the results are applicable to sugarcane being managed for maximum yield and ripening response. Even treatment W1 in experiment 4 experienced severe soil moisture stress between 2 and 4 weeks after ripener application, contrary to the requirements for a good ripening response to be obtained (See objective 3 on page 1). Thus, in my opinion, this data is not relevant to the well-grown sugarcane that is normally chemically ripened.

3. I agree that one must transport more sucrose per load when distances are great but I question whether lower topping will achieve this objective with loose or bundled cane that had been topped correctly in the first place. Whether stalks are 1,8m long, or 1,5m long is unlikely to make any difference to the number of bundles carried per load. It will, of course make a difference if the cane has been chopper harvested, but this is not a common practice.

H. Rostron
24 Dec.1986

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

Ripeners and related aspects.

BY

R Donaldson and B Ashburner

A. King
T. Rase

The objective of using ripeners is

° To improve cane quality when conditions favour vegetative growth.

By following the guidelines set out below one could maximise the benefits from using ripeners.

° Select vigorously growing cane : More than 8 green leaves, long upper internodes and is likely to yield more than 85 tons cane ha^{-1}.

° The above point would therefore exclude all cane which is stressed periodically or is likely to suffer from stress before or after applying the ripener. Under rainfed conditions it would therefore be necessary to have determined whether the soil profile holds sufficient moisture to maintain vigorous growth for 7 to 9 weeks after spraying. Irrigated cane will only be dried off to create suitable conditions to avoid damage from infield transport.

° The date of applying the ripener should be scheduled so that the intervals between spraying and harvesting for each of the ripeners is

	Early season	Late season
Polado	6 to 10 weeks	8 to 10 weeks
Ethrel	6 to 12 weeks	—
Fusilade super	6 to 10 weeks	4 to 8 weeks

Applying ripeners to cane harvested in August and September is not generally recommended. However should the above requirements be met during these periods then applying an inexpensive ripener may well be of substantial benefit.

° Ripened cane should be topped within centimeters of the growing point.

Some other factors that require attention

° Clean water should always be used.

° Spray tanks should be clean before loading.

° Avoid spraying cane with more than 20% flowering.

° The response from lodged cane may only be 50% of that from upright cane.

° Selecting the most suitable chemical for your particular conditions.

° Demarcation of fields to (a) avoid confusion of areas to be sprayed
(b) keep time of spraying to a minimum (R556.00/hr).

° Weather conditions should be such that distribution of the chemical is even.

The economic optimum of ripener use.

Ripeners are applied at a fixed recommended rate and to get the economic optimum return from their use implies that the above guidelines be applied as closely as possible, i.e. good management.

However, two questions arise as to whether using a ripener is the economic optimum for the farm as a whole.

Firstly, what is the benefit of using a ripener as opposed to using the best alternative recommended practice ?

Secondly, what is the "risk" involved in obtaining the response needed to be in exactly the same position as the best recommended alternative ?

The following Table I gives yield figures for different practices on irrigated cane.

TABLE I. The yield figures for different practices.

Practice	Tons cane per ha	Tons sucrose per ha	Sucrose % cane
Low accurately topped and well dried off	92	12,68	13,78%
High accurately topped and well dried off	105	13,12	12,50%
High accurately topped, ripened and not dried off	114	14,83	13,01%

High accurately topped and well dried off yields were assumed as a base point.

The low accurately topped and dried off yields were obtained by applying the percentage reduction in yields obtained from the Management and Productivity Modular Course 1983 'Height of topping' notes, Table I to the base yields.

The high accurately topped ripened and not dried off cane yields were obtained from applying the percentage change in yields from the SASTA paper by R. Donaldson to the base year.

These yields were not obtained from the same experimental data and thus the validity of the method used to obtain the yields is highly questionable.

However, in practice the yield figures may follow a similar pattern and it is the principle that is being illustrated.

Having the yield figures for the different practices it must now be determined which method will be the most beneficial.

Up to the point of actually deciding to apply a ripener all costs incurred would be fixed at the same level. The costs that vary per ton of cane delivered (including transport and levies) would vary with the practice chosen. The other costs that need to be considered are :

i) The actual ripener and its application. These costs would be Roundup ± R40/ha. Fusilade Super ± R28/ha. Ethrel ± R113/ha. The application method in all cases is an aerial spray.

ii) The cost of continuing irrigation on ripened cane for ± 6 weeks. In practice it can be argued that the irrigation costs will not increase due to the small proportion of area ripened. However, at some stage there may be a direct cost increase due to the regular use of ripeners on larger proportions of the farm. No cost has been included in this example.

iii) Cutting costs are generally linked to tons of cane however, to pay cutters less to top low would not make good sense, thus cutting costs have been considered fixed per ha regardless of yield.

iv) Other factors such as a better burn and easier cutting, improved quality (not just sucrose) may have economic implication, now and in the future.

In most cases any increases in yields from the same area of land would be sold at the marginal or 'B' pool price. If it is felt that ripening could become a guarranteed regular practice then land could be withdrawn for an alternative crop and the 'A' pool price would need to be used. However, generally any increase in yield due to ripeners will be for the 'B' pool. A 'B' pool price of R140/ton sucrose was used.

Table II shows the financial benefits of using the various practices mentioned and with the assumptions made above.

TABLE II. Comparison of benefits of alternative practices including ripened cane with different levels of variable costs.

Practice Comparisons	Variable Cost Levels		
	Level (1) R6 (R/ha)	Level (2) R8 (R/ha)	Level (3) R10 (R/ha)
Low accurate topped vs High accurate topped both dried off	4	17	30
High accurately topped ripened (Roubdup) vs Low accurately topped dried off	159	137	115
High accurately topped ripened (Fusilade) vs Low accurately topped dried off	171	149	127
High accurately topped Ripened (Ethrel) vs Low accurately topped dried off	86	64	42

From Table II it can be seen that the benefits from topping low as opposed to high, range from R4/ha to R30/ha as variable costs (mostly transport cost) increase. Thus the further from the mill generally the more important it is to top low to increase the efficiency of transport with good quality cane.

The next three comparisons are between ripened cane using the three registered ripeners and the next best alternative of topping low and drying off. The benefits of ripening with Fusilade, range from R170/ha to about R130/ha as variable costs increase. The other ripeners show the same trend and it is really the cost of the ripener itself that makes the difference in benefits. Thus the higher the transport costs, the less the benefit from ripening.

The first question has been answered. Ripening with the yields used in this example is the economically optimum practice.

The second question can be answered by calculating the break-even point in terms of sucrose so that ripened cane give the same monetary returns as low accurately topped and dried off cane.

Table III shows the increase in yield needed above that of low accurately topped dried off cane from ripened cane to give a break-even point in terms of tons sucrose per ha. If this level of sucrose yield is not likely then the risk of ripening may be too great.

TABLE III. The increase yield of ripened cane needed to give the same returns as Low accurately topped dried off cane in terms of tons sucrose per ha.

		Variable Cost		
		Level (1) ts/ha	Level (2) ts/ha	Level (3) ts/ha
Break even yield needed from ripened cane to give the same return as Low accurately topped dried off cane	Roundup	1,01	1,17	1,33
	Fusilade	0,93	1,08	1,24
	Ethrel	1,53	1,69	1,85

From Table III it can be seen that by using Fusilade a yield increase of 0,93 tons sucrose per ha would be needed at level (1) variable costs just to break even with the practice of topping low and drying off. Thus the risk of achieving at least this yield can be established and the decision as to whether to ripen or not can be made.

Notes on Cane Haulage From Field To Mill

By : P. G. Braithwaite

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Generally the movement of cane in a cane haulage system is carried out in three stages ;

1. From field to zone
2. Transhipment
3. From zone to mill

1. Field to Zone

   1. Options: Trash, Burn
      Bundle, windrow
      Whole stick, chopped

   2. Factors Tons moved per load
      Loading time
      Travelling time (Field layout)
      Unloading time

Table 1
Field to Zone - Costs

Method	Loading Time (Mins)	Unload. Time (Mins)	Travel. Time (Mins)	Time (Mins)	Tons/ Hour	Cost Hour (R.)	Cost Ton (R/Hr)
52 kw & rear loader	9,0	5,0	12,0	26,0	9,23	15	1.68
52 kw & side loader	6,5	4,5	12,0	23,0	10,43	15	1,44
52 Kw & side loader	4,5	4,5	9,0	18,0	13,33	15	1,13
52 Kw & Box trailer	8	3	11,0	22,0	16,36	16	0,98

Table 1 shows the comparitive effect of the various factors on tons/hour delivered on zone and the subsequent cost ton, assuming good utilization and a 2 Km round trip from field to zone.

2. Transhipment:

2.1. Options — Bundle, Bundle/loose, loose, pallets

2.2. Factors — Loading time
Payload
Capital Cost
Labour on zone

Table 2
Crane Cost

	c/Ton
Grab Loader Infield	0,38
Crane(Loose)(Load) Bundles	0,63
Crane(Bundles)(Load)	0,42
Crane (Off load)	0,52
Grab Loader (On Zone)	0,48

Costs on zone can be very high if the labour and capital costs are not carefully considered. Table 2 gives some comparitive costs, assuming good utilization. It is interesting to note a bundle chain system may require three extra labourers, when compared to a loose cane system.

3. Zone to Mill :

3.1. Option — Bundle, Loose, Pallets
Tractors, truck tractors, trailer size, rail

3.2. Factors — Density of cane
Tons moved per load
Loading time
Travelling time
Unloading time
System used by mill
Hours worked/ day
Contractor or self

From the available options the ideal system can be built up according to the needs of the Grower. A number of systems have been selected and comparitive costs are shown assuming 100000t/annum 10 Km from the mill

System 1	Hand cut, trash, bundles, side loader, crane off load, loose, hilo to mill
System 2	Burn, hand cut, m/c load, tipped on zone, loose loaded, hilo to mill
System 3	As system (1) but bundle to the mill
System 4	As system (1) but spill on zone and load loose cane.

COMPARATIVE COST OF SYSTEMS

	System (1)	System (2)	System (3)	System (4)
Cut	2,70	2,20	2,70	2,70
M/C Load	-	0,57	-	-
Tractor & Trailer	1,41	1,20	1,41	1,41
Zone off load	0,66	-	0,66	-
Load Hilo	0,77	0,47	0,56	0,47
HIlo to Mill	1,32	1,42	1,21	1,42
Chains	0,15	-	0,15	-
	7,01	5,86	6,69	6,00

P.Braithwaite
21.10.1986

PGB/mh

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

THE REPLANT DECISION

BY

RODGER STEWART

P. Dovey.

1. INTRODUCTION

The replant decision is one of the most critical decisions faced by a Grower. As with any capital replacement decision there are two parts to the decision, firstly when to plough-out and secondly with what to replace the existing variety. The long term consequences of these decisions are critical to the success of a farm.

Table 1 shows that 9% of total annual costs are spent on land preparation, seedcane and the planting operation for a farm with a 10% replant policy. Whilst this is not a large proportion of total cost, it does offer the Eldana-stricken Coastal Grower, who is forced to harvest and therefore ratoon large portions of his farm, the only area of cost reduction. This flexibility is investigated in the following section.

Table 1: Operational costs as a percentage of total costs for a 260ha farm, 10% replant cycle, harvesting 12 000 tons cane/annum, with an in field haul of 2km and a haul to the mill of 30km.

	% of total cost
Land preparation	4
Seedcane	3
Planting operation	2
Planting materials	5,5
Replant cost	14,5
Ratoon cost	35,5
Harvest & transport	50,0
TOTAL	100

(S.A. Cane Growers Association, 1986)

2. PLOUGH-OUT CYCLE

The Experiment Station has suggested that 10% of area under cane should be ploughed out every year. This is a well balanced recommendation for the development of a farm. Once disease-free varieties have been established and good agronomic practice employed, the percentage of area to be re-established every season should be more critically examined.

Hoekstra (1976) provides a method of analysis of when to plough out a field. All available records of New Guelderland Sugar Estates (Pty) Ltd. up to and including the 1979/80 season were analysed to obtain a standard yield which removed the variances caused by age, season, nitrogen fertilizer and starting month of crop. (Hoekstra, 1981) Appendices 1 to 3 use the standard yields obtained for better and poor quality soils with current cost and revenue figures to determine the optimum plough-out cycles for Bonheim, Glenrosa and Fernwood soils. Table 2 provides a summary of the results of these appendices.

Table 2 : Optimum plough-out cycles, discounted future profits and standardized threshold levels.

	Soil Form		
	Bonheim	Glenrosa	Fernwood
A Pool Prices			
Optimum plough-out cycles (Ratoons)	11	8	6
Discounted future profit (R/ha)	14 492	13 064	11 112
Plough-out threshold (T/ha/month)	6,77	6,25	5,98
B Pool Prices			
Optimum plough-out cycles (Ratoons	16	11	9
Discounted future profits (R/ha)	4 022	3 281	1 587
Plough-out threshold (T/ha/month)	5,99	5,41	5,03

Table 2 shows that the economic optimisation of plough-out cycles is affected by the price of cane. If a Grower has substantial quantities of cane that have to be sold at B Pool prices, it would seem that longer plough-out cycles would provide for more profitable farming. The difference in soil forms is also critical. It can be seen that the different soil forms have different yield and cost profiles which indicate that different plough-out cycles should be applied to different soil types. The relatively poor performance and the high ratoon management cost of the Fernwood soil form indicates a more rapid plough-out cycle than that for better quality Bonheim soils.

Whilst these figures may be considered to be theoretical because of the assumptions made in standardizing yield and in the determination of a discount factor, the method does provide an indication of an economic optimum plough-out cycle.

3. OTHER CONSIDERATIONS

3.1 Varieties

Whilst the analysis above attempts to define an economic optimum cycle, consideration has to be given to the available replacement varieties. The question of whether replacement varieties offer sufficient improvement in disease resistance is important. In the Natal coastal areas it has been suggested that N12 is a suitable replacement of NCo 376. The disease resistance patterns of N12 are an improvement on NCo 376. However, it is considered that the improvement that N12 gives may not warrant an immediate plough-out and variety change. It is considered that because of the very long-term nature of the plough-out decision in soils such as the Bonheim soil form that ratoons could be allowed to go over the economic optimum so as to ensure that at plough-out the replacement variety will be a considerable improvement on the current variety.

The matching of varieties to soil conditions in particular, is of great importance to the Grower faced with Eldana. Consideration needs to be given to the selection of different varieties for different soil types that may appear in the same block. If there are shale patches in a dolerite block it is considered that a suitable variety should be grown in the shale and a different one in the dolerite. This should ensure optimum production with the minimum danger from Eldana.

3.2 Partial replanting

Many fields have small areas or edges where ratoon failure becomes a problem. It is suggested that replanting of these areas would practically extend the life of the field. If poor areas and edges of the field are subject to ratoon failure due to drought or Eldana, specific varieties should be grown to overcome these problems.

3.3 General agronomy

The standard agronomic practices suggested by the Experiment Station are sufficient to ensure disease-free, weed-free and well fed cane crops. Experience on New Guelderland Sugar Estates has shown that if a field shows signs of deterioration after approximately 6 or 7 ratoons, that special care by changing agronomic practices such as burning and ripping as opposed to trashing or increasing fertilizer or cutting the field at an optimum time of the year seems to extend the life of the field. Hasty plough-out decisions should be avoided.

3.4 Drought

Table 3 shows the production record of Field 236 of New Guelderland Sugar Estates. This field has shallow Mispah and Glenrosa soil forms. During the last few drought years it has had to be harvested at a very young age to ensure its survival. The recovery of this field after the severe droughts of 1981 and 1983 after its 7th and 9th ratoons is encouraging. Approximately 3ha of this field have been re-established due to ratoon failure after the drought of 1983.

TABLE 3: FIELD HISTORY OF FIELD 236

Soil type - Parent material: Lower Ecca
Soil Form: Glenrosa
Depth: 300-400mm
Date planted: 11/1968
Variety: NCo 376
Area (Ha): 22,2

Stage	Harvest Date	Tons Cane	Rainfall (mm)	Trash/ Burn	Sucrose (%)	Age (mnths)	Tons cane /ha	Tons cane /ha/month	Tons cane /ha/100mm	Fertilizer Kg Nutrient/Ha N	P	K
Plant	05/70	1974	1370	Trash	13.25	18	88.9	4.94	6.49	150	50	150
1R	01/72	2734	1694	Trash	13.47	20	123.2	6.16	7.27	158	0	0
2R	08/73	2608	1350	Trash	14.20	19	117.5	6.18	8.70	180	0	10
3R	10/74	1531	1007	Trash	14.21	14	69.0	4.93	6.85	160	9	54
4R	07/76	2854	2342	Trash	12.44	21	128.6	6.12	5.49	140	0	40
5R	12/76	1701	1271	Trash	12.55	17	76.6	4.51	6.03	179	19	79
6R	06/79	2123	1266	Burn	14.04	19	95.6	5.03	7.55	121	24	121
7R	06/81	1115	1887	Burn	9.61	24	50.2	2.09	2.66	122	0	67
8R	08/82	1380	1034	Trash	13.34	13	62.2	4.78	6.01	140	10	156
9R	08/83	357	683	Burn	11.78	12	16.1	1.34	2.35	112	12	60
10R	04/85	2205	2653	Trash	12.63	22	99.3	4.51	3.74	115	0	115
11R	06/86	934	998	Trash	10.82	14	42.1	3.01	4.22	114	0	0
AVERAGE		1793	1463		12.70	17.8	80.8	4.47	5.61			

4. CONCLUSION

The economic optimization of the replant decision is one of the few cost saving strategies, besides improvement in productivity, for dryland Growers facing Eldana. The introduction of the Pool system indicates that longer plough-out cycles should be considered for all soil types. Changes to standard agronomic practices assist in achieving greater numbers of ratoons.

REFERENCES

Hoekstra, R.G. (1976) Analysis of When to Plough Out a Sugar Cane Field. Proceedings of the South African Sugar Techonologists' Association - June 1976.

Hoekstra, R.G. (1981) Third Consultancy Report for New Guelderland Sugar Estates (Pty) Ltd.

S.A. Cane Growers Association (1986) Personal communication.

NEW GUELDERLAND SUGAR ESTATES (PTY) LTD — BONHEIM SOIL FORM — APPENDIX 1

PLOUGH-OUT OPTIMIZATION

Assumptions

		Actual	Forward Discount To Harvest
Harvest Cycle (months)	17		
Fallow Period (months)	5		
Standardized Plant Crop Yield (tc/ha)	141.9		
Standardized Yield Decline Per Ratoon (tc/ha)	2.39		
Average Sucrose Content (Suc % cane)	12.2		
Discount Factor (%/annum)	15		
Ratoon Maintenance Cost (R/ha)		450	549
Plough-out & Replant Cost (R/ha)		1650	2011
Harvest & Transport Cost (R/ton cane)	7.50		
A Pool Sucrose Price (R/ton sucrose)	290		
B Pool Sucrose Price (R/ton sucrose)	140		
Transport Refund (R/ton cane)	4.45		

OPTIMUM PLOUGH-OUT CYCLE AT A POOL PRICE OF CANE

Ratoon Stage	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Age (years)	1.83	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
Yield (tc/ha)	142	140	137	135	132	130	128	125	123	120	118	116	113	111	108	106	104	101	99	96
Profit (R/ha)	2028	3962	3885	3807	3730	3653	3575	3498	3421	3344	3266	3189	3112	3035	2957	2880	2803	2726	2648	2571
Cumulative Age (years)	1.83	3.25	4.67	6.08	7.50	8.92	10.33	11.75	13.17	14.58	16.00	17.42	18.83	20.25	21.67	23.08	24.50	25.92	27.33	28.75
Discount Factor	0.77	0.63	0.52	0.43	0.35	0.29	0.24	0.19	0.16	0.13	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02
Discounted Profit (R/ha)	1569	2516	2023	1627	1308	1051	844	677	543	436	349	280	224	179	143	114	91	73	58	46
Discounted Profit Per Cycle (R/ha)	1569	4085	6108	7735	9043	10093	10937	11614	12157	12593	12942	13222	13445	13624	13768	13982	13973	14046	14104	14150
Total Discounted Future Profit (R/ha)	6943	11190	12749	13507	13924	14168	14314	14402	14452	14479	14490	14492	14487	14479	14468	14456	14444	14432	14420	14410
Plough-out Cycle Length	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Maximum Total Discounted Future Profit (R/ha) 14492
Optimum Plough-out Cycle Length 11 Ratoons
Plough-out Threshold Level 115 t cane/ha = 6.77 t cane/ha/month

OPTIMUM PLOUGH-OUT CYCLE AT B POOL PRICE OF CANE

Ratoon Stage or Plough-out Cycle Length	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Age (years)	1.83	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
Yield (tc/ha)	142	140	137	135	132	130	128	125	123	120	118	116	113	111	108	106	104	101	99	96
Profit (R/ha)	-569	1409	1375	1342	1308	1275	1241	1208	1174	1141	1107	1073	1040	1006	973	939	906	872	839	805
Cumulative Age (years)	1.83	3.25	4.67	6.08	7.50	8.92	10.33	11.75	13.17	14.58	16.00	17.42	18.83	20.25	21.67	23.08	24.50	25.92	27.33	28.75
Discount Factor	0.77	0.63	0.52	0.43	0.35	0.29	0.24	0.19	0.16	0.13	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02
Discounted Profit (R/ha)	-440	894	716	573	459	367	293	234	186	149	118	94	75	59	47	37	30	23	18	14
Discounted Profit Per Cycle (R/ha)	-440	454	1171	1744	2202	2569	2862	3096	3282	3431	3549	3643	3718	3777	3824	3862	3891	3914	3933	3947
Total Discounted Future Profit (R/ha)	-1948	1244	2443	3045	3391	3606	3746	3839	3902	3944	3974	3993	4006	4014	4019	4021	4022	4022	4021	4020
Plough-out Cycle Length	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Maximum Total Discounted Future Profit (R/ha) 4022
Optimum Plough-out Cycle Length 16 Ratoons
Plough-out Threshold Level 102 t cane/ha = 5.99 t cane/ha/month

NEW GUELDERLAND SUGAR ESTATES (PTY) LTD

GLENROSA SOIL FORM

APPENDIX 2

PLOUGH-OUT OPTIMIZATION

Assumptions

		Actual	Forward Discount To Harvest
Harvest Cycle (months)	17		
Fallow Period (months)	5		
Standardized Plant Crop Yield (tc/ha)	136.2		
Standardized Yield Decline Per Ratoon (tc/ha)	3.71		
Average Sucrose Content (Suc % cane)	12.2		
Discount Factor (%/annum)	15		
Ratoon Maintenance Cost (R/ha)		470	573
Plough-out & Replant Cost (R/ha)		1650	2011
Harvest & Transport Cost (R/ton cane)	7.50		
A Pool Sucrose Price (R/ton sucrose)	290		
B Pool Sucrose Price (R/ton sucrose)	140		
Transport Refund (R/ton cane)	4.45		

OPTIMUM PLOUGH-OUT CYCLE AT A POOL PRICE OF CANE

Ratoon Stage	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Age (years)	1.83	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
Yield (tc/ha)	136	132	129	125	121	118	114	110	107	103	99	95	92	88	84	81	77	73	69	66
Profit (R/ha)	1819	3710	3591	3471	3351	3231	3111	2991	2871	2751	2631	2511	2391	2271	2151	2031	1911	1791	1671	1551
Cumulative Age (years)	1.83	3.25	4.67	6.08	7.50	8.92	10.33	11.75	13.17	14.58	16.00	17.42	18.83	20.25	21.67	23.08	24.50	25.92	27.33	28.75
Discount Factor	0.77	0.63	0.52	0.43	0.35	0.29	0.24	0.19	0.16	0.13	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02
Discounted Profit (R/ha)	1408	2356	1870	1483	1175	929	734	579	456	358	281	220	172	134	104	81	62	48	37	28
Discounted Profit Per Cycle (R/ha)	1408	3764	5634	7117	8292	9221	9955	10534	10990	11348	11629	11849	12021	12155	12259	12340	12402	12450	12487	12515
Total Discounted Future Profit (R/ha)	6229	10310	11760	12428	12765	12943	13029	13062	13064	13048	13021	12988	12953	12917	12883	12850	12820	12792	12767	12744
Plough-out Cycle Length	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Maximum Total Discounted Future Profit (R/ha) 13064
Optimum Plough-out Cycle Length 8 Ratoons
Plough-out Threshold Level 106 t cane/ha = 6.25 t cane/ha/month

OPTIMUM PLOUGH-OUT CYCLE AT B POOL PRICE OF CANE

Ratoon Stage or Plough-out Cycle Length	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Age (years)	1.83	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
Yield (tc/ha)	136	132	129	125	121	118	114	110	107	103	99	95	92	88	84	81	77	73	69	66
Profit (R/ha)	-673	1286	1234	1182	1130	1078	1026	974	922	870	817	765	713	661	609	557	505	453	401	349
Cumulative Age (years)	1.83	3.25	4.67	6.08	7.50	8.92	10.33	11.75	13.17	14.58	16.00	17.42	18.83	20.25	21.67	23.08	24.50	25.92	27.33	28.75
Discount Factor	0.77	0.63	0.52	0.43	0.35	0.29	0.24	0.19	0.16	0.13	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02
Discounted Profit (R/ha)	-521	816	643	505	396	310	242	188	146	113	87	67	51	39	29	22	16	12	9	6
Discounted Profit Per Cycle (R/ha)	-521	295	938	1443	1839	2149	2391	2580	2726	2839	2926	2994	3045	3084	3113	3136	3152	3164	3173	3179
Total Discounted Future Profit (R/ha)	-2305	809	1958	2520	2832	3017	3129	3199	3240	3264	3277	3281	3281	3277	3272	3265	3258	3251	3244	3237
Plough-out Cycle Length	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Maximum Total Discounted Future Profit (R/ha) 3281
Optimum Plough-out Cycle Length 1[illegible]atoons
Plough-out Threshold Level 92 [illegible] cane/ha = 5.41 t cane/ha/month

NEW GUELDERLAND SUGAR ESTATES (PTY) LTD — FERNWOOD SOIL FORM — APPENDIX 3

PLOUGH-OUT OPTIMIZATION

Assumptions

		Actual	Forward Discount To Harvest
Harvest Cycle (months)	17		
Fallow Period (months)	5		
Standardized Plant Crop Yield (tc/ha)	136.2		
Standardized Yield Decline Per Ratoon (tc/ha)	5.50		
Average Sucrose Content (Suc % cane)	12.2		
Discount Factor (%/annum)	15		
Ratoon Maintenance Cost (R/ha)		700	853
Plough-out & Replant Cost (R/ha)		1800	2194
Harvest & Transport Cost (R/ton cane)	7.50		
A Pool Sucrose Price (R/ton sucrose)	290		
B Pool Sucrose Price (R/ton sucrose)	140		
Transport Refund (R/ton cane)	4.45		

OPTIMUM PLOUGH-OUT CYCLE AT A POOL PRICE OF CANE

Ratoon Stage	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Age (years)	1.83	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
Yield (tc/ha)	136	131	125	120	114	109	103	98	92	87	81	76	70	65	59	54	48	43	37	32
Profit (R/ha)	1356	3372	3194	3017	2839	2661	2483	2305	2128	1950	1772	1594	1416	1238	1061	883	705	527	349	172
Cumulative Age (years)	1.83	3.25	4.67	6.08	7.50	8.92	10.33	11.75	13.17	14.58	16.00	17.42	18.83	20.25	21.67	23.08	24.50	25.92	27.33	28.75
Discount Factor	0.77	0.63	0.52	0.43	0.35	0.29	0.24	0.19	0.16	0.13	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02
Discounted Profit (R/ha)	1049	2141	1664	1289	995	765	586	446	338	254	189	140	102	73	51	35	23	14	8	3
Discounted Profit Per Cycle (R/ha)	1049	3191	4855	6144	7139	7904	8490	8936	9274	9528	9717	9857	9959	10032	10083	10118	10141	10156	10163	10166
Total Discounted Future Profit (R/ha)	4643	8740	10132	10728	10992	11095	11112	11081	11025	10955	10889	10804	10731	10661	10596	10537	10483	10434	10391	10352
Plough-out Cycle Length	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Maximum Total Discounted Future Profit (R/ha) 11112
Optimum Plough-out Cycle Length 6 Ratoons
Plough-out Threshold Level 102 t cane/ha = 5.98 t cane/ha/month

OPTIMUM PLOUGH-OUT CYCLE AT B POOL PRICE OF CANE

Ratoon Stage or Plough-out Cycle Length	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Age (years)	1.83	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
Yield (tc/ha)	136	131	125	120	114	109	103	98	92	87	81	76	70	65	59	54	48	43	37	32
Profit (R/ha)	-1137	980	903	826	749	672	595	517	440	363	286	209	132	54	-23	-100	-177	-254	-331	-409
Cumulative Age (years)	1.83	3.25	4.67	6.08	7.50	8.92	10.33	11.75	13.17	14.58	16.00	17.42	18.83	20.25	21.67	23.08	24.50	25.92	27.33	28.75
Discount Factor	0.77	0.63	0.52	0.43	0.35	0.29	0.24	0.19	0.16	0.13	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02
Discounted Profit (R/ha)	-880	623	471	353	263	193	140	100	70	47	31	18	9	3	-1	-4	-6	-7	-7	-7
Discounted Profit Per Cycle (R/ha)	-880	-257	213	566	829	1022	1162	1263	1333	1380	1410	1429	1438	1441	1440	1436	1431	1424	1417	1409
Total Discounted Future Profit (R/ha)	-3891	-704	445	989	1276	1435	1521	1566	1584	1587	1579	1566	1550	1532	1514	1496	1479	1463	1448	1435
Plough-out Cycle Length	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Maximum Total Discounted Future Profit (R/ha) 1587
Optimum Plough-out Cycle Length 9 Ratoons
Plough-out Threshold Level 86 t cane/ha = 5.03 t cane/ha/month

S.A. SUGAR INDUSTRY AGRONOMIST'S ASSOCIATION

FRAMEWORK FOR DISCUSSION OF OVERALL THEME

By John Boyce, Tongaat-Hulett Sugar

"The economic optimisation of Agricultural practices under the current climate."

1. Sensitivity to priorities

The Committee decided to base the Agenda on those practices which constitute the highest proportions of total direct operational costs. Appendix I provides a simple analysis of costs as percentages of total costs in one particular situation.

2. Sensitivity to Current climate

Appendix II shows the changes in proportions of total direct costs for different situations. The effects of crop restriction, severe drought and distance from Mill, show wide variations for a typical large farm (Appendix III).

3. Approach by Discussion Leaders

Economic optimisation of agricultural practices involves complex decisions concerning values and attitudes towards risk and judgements about uncertainties. The definition of the current climate of sugarcane farming in South Africa must also be addressed. The technical problems and recent research findings concerning agricultural practices will provide further material for discussion.

JPB.4/cw
20th October 1986

APPENDIX I

SENSITIVITY TO PRIORITIES

OPERATIONS	% of TOTAL COST
Land preparation	4
Seedcane	3
Planting operation	2
fertilizer	2
nematicide	0,5
weed control	3
REPLANT COST %	14,5
Ratoon fertilizer	18
nematicide	0,5
weed control	17
RATOON COST %	35,5
Harvesting cutting	13
infield transport	9
HARVESTING COST %	22
Cane loading	4
Cane haulage	24
TRANSPORT COST %	28
TOTAL DIRECT COST %	100

APPENDIX II

SENSITIVITY TO CURRENT CLIMATE

SITUATIONS	NORMAL		RESTRICTION		DROUGHT	
Crop tc	60 000		45 000		45 000	
Haulage cost / tc	R2,21	R11,50	R2,21	R11,50	R2,21	R11,50
Area harvest ha	848	848	636	636	848	848
Yield tc / ha	70,8	70,8	70,8	70,8	53,1	53,1
Direct costs / tc	R18,30	R27,60	R19,60	R28,90	R22,10	R31,40
PROPORTIONS						
% replant costs	19	13	24	16	21	15
% fertilizer costs	21	14	19	13	23	16
% weed control costs	20	13	19	13	22	16
% harvest costs	21	14	20	13	17	12
% transport costs	17	45	16	43	14	39
% other costs	2	1	2	2	3	2

HYPOTHETICAL CANE FARM   NORMAL SEASON: 60000 tc   Haulage/tc: 2.21

APPENDIX III

1260 Ha under cane	% area harvest:	67.30 %
60000 tc per annum	% area replant:	10.60 %
134 Ha replant	yield/ha/annum:	47.60 tc/ha under cane
848 Ha harvest	yield/ha harv.:	70.80 tc/ha

	WORKLOAD	UNIT COST	TOTAL COST Rands	COST/TON Rands	PERCENT of TOTAL
Land prep	134 ha	430.00 per ha	57620	0.96	5.25
Seedcane	134 ha	300.00 per ha	40200	0.67	3.66
Planting	134 ha	240.00 per ha	32160	0.54	2.93
Plant cult	134 ha	581.94 per ha	77980	1.30	7.10
Fertiliser	134 ha	260.00 per ha	34840	0.58	3.17
Nematicide	33 ha	150.00 per ha	4950	0.08	0.45
Weed control	134 ha	285.00 per ha	38190	0.64	3.48
chemicals	134 ha	140.00 per ha	18760	0.31	1.71
labour	134 ha	130.00 per ha	17420	0.29	1.59
tractors	134 ha	15.00 per ha	2010	0.03	0.18
REPLANT COSTS	134 ha	1551.94 per ha	207960	3.47	18.95
Ratoon cult	848 ha	559.45 per ha	474415	7.91	43.22
Fertiliser	848 ha	270.00 per ha	228960	3.82	20.86
Nematicide	135 ha	185.00 per ha	24975	0.42	2.28
Weed control	848 ha	260.00 per ha	220480	3.67	20.09
chemicals	848 ha	110.00 per ha	93280	1.55	8.50
labour	848 ha	140.00 per ha	118720	1.98	10.82
tractors	848 ha	10.00 per ha	8480	0.14	0.77
Cane cutting	60000 tc	2.76 per ton	165600	2.76	15.09
Infield transport	60000 tc	1.08 per ton	64800	1.08	5.90
HARVESTING	60000 tc	3.84 per ton	230400	3.84	20.99
Cane loading	60000 tc	0.87 per ton	52200	0.87	4.76
Cane haulage	60000 tc	2.21 per ton	132600	2.21	12.08
TRANSPORT	60000 tc	3.08 per ton	184800	3.08	16.84
TOTAL DIRECT COSTS	60000 tc	18.29 per ton	1097[illegible]5	18.29	100.00

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS ASSOCIATION

AGM 1986

O. Mann.

"The economic optimisation of agricultural practises in the current climate".

AN INTEGRATED SYSTEMS APPROACH AT UMFOLOZI MILL

1. THE CONCEPT

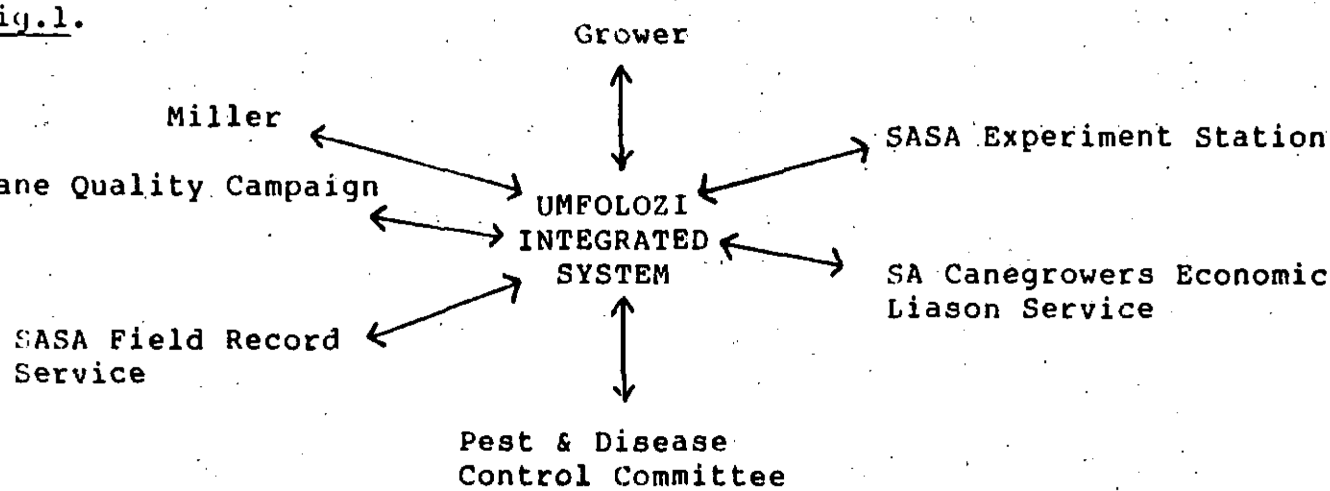
An integrated system causes people with common interests to co-operate with each other and supportive organisations, in order to utilise available resources for maximum benefit to all.

It is necessary to measure and evaluate the effects of the system in order to improve it.

2. THE COMPONENTS

Figure 1 illustrates the major components of the "Umfolozi Integrated System". Section 3 provides details.

Fig.1.



3. COMMON INTEREST & CAUSE

Miller and Grower: Umfolozi is a co-operative mill. This causes millers and growers to have a common interest, namely the manufacture of sugar for maximum profit. Good cane quality is therefore economically important to both sectors. Involvement is 100%.

Growers have been grouped into 7 homogeneous zones with Kwa Zulu growers forming zone no. 8. System data is collected and analysed by zones and the mill group.

Cane Quality Campaign (CQC)

In 1985 it was decided to campaign for improved cane quality. This was motivated by a strained economic climate within the co-operative due mainly to:

* A very severe drought in 1983
* The devastating floods of 1984
* A poor cane quality performance compared to industrial average since 1983 - see figures 2 to 7 in Appendix A.

Major implementation steps in the campaign were

* Displaying to each grower the co-operative's "A" pool value per ton of cane for every consignment sent by him to the mill and emphasising cane quality factors and ash % cane (damage to mill).

The medium used is the SICB Cane Testing Service weekly return - see Appendix B, which includes the growers "working notes".

* The formation of a Cane Quality Campaign Committee.

Representatives from the miller, the growers of each zone, SASEX and any other concerned person constitute the committee. To assist this committee a weekly printout (by homogeneous zone) ranks growers according to cane quality performance and cane quality factors are detailed - see Appendix C. Finally the mean cane: sugar ratio and ash % cane are detailed and compared by homogeneous zone and cane loading systems.

* To co-ordinate effort a Cane Quality Controller was employed.
* The campaign was publicised by correspondence and meetings and approved by miller and growers. Involvement is 100%.

SASA Field Record Service (FRS)

This will provide the data base of agronomic performance.

Umfolozi cane payment is based on relative sugar. The FRS has been modified to provide a yield unit of tons relative sugar/ hectare/annum and cane:sugar ratio as the production efficiency indicator.

Data will be available by the field, by the quota, by homogeneous zone and by the mill group.

This system was initiated in 1986 and as a percentage of estimated crop Involvement is 70%.

SASA Experiment Station (SASEX)

SASEX provides specialist advice on sugarcane and services such as the Fertiliser Advisory Service and Training.

The resident Extension Officer provides a local advisory service and uses his knowledge of the area to promote agricultural practises that will enhance profitability. He may also act as a catalyst in such projects as are outlined in this presentation. The communication link between grower and Extension Officer is such that, by choice, Involvement can be 100%.

Umfolozi Pest & Disease Control Committee (UP & DC)

This comprises of miller and grower representatives supported by SASEX in the form of a Pest and Disease Control Officer (with a team) and the Extension Officer.

The committee's function is self explanatory and in addition it has initiated and supported seedcane schemes. Thousands of tons of certified and approved seedcane have entered the "Umfolozi Integrated System" since 1983 and the replacement of smut prone varieties with more resistant varieties has been significant.

To date good grower co-operation has resulted in minimal regulatory activity. Involvement of growers is 100% by choice or regulation.

SA Canegrowers Economic Liason Service (CELS)

The integration niche envisaged for this service is to provide a data bank of production costs and other farm management data by homogeneous area, by rainfed and irrigated conditions and by mill group.

To date the concept has been accepted by organised agriculture (SA Canegrowers and Farmers Associations) and the Chairman, Mill Group Board of Directors. The recruiting programme for grower participants has not yet commenced. Current "Cane Farms" Involvement is 11% of quotas.

4. MEASURE AND EVALUATE (underlined)

Miller System trends in factors affecting cane quality from 1977/78 to 1986/87 (TD) compared to the industry average are illustrated in Appendix A, figures 2 to 7.

Table 1 shows 1986 performance figures as at 6/10/86 compared to 1985 performance figures as at 9/11/85.

Final estimates indicate the 1986 crop will be within 2,5% of the 1985 tonnage crushed.

Table 1. Umfolozi Mill Performance 1986 x 1985
Same tonnage crushed (± 70% of total)

		1986
Days crushing a) Total less	-	18 days
b) % less	-	10,5%
Additional sugar made	+	4 064 tons (5,6%)
Tons less coal burned	-	3 036 tons
Additional revenue & savings		
a) Sugar at R3,03/ton "B" pool	+	R1 231 392
b) Coal saving at R40/ton	+	R 121 400
Total value		R1 352 792

Essentially Umfolozi has made a remarkable improvement in cane quality since 1985, but can still improve when compared to its sister "Union Co-operative", and its own historical performance since 1977/78.

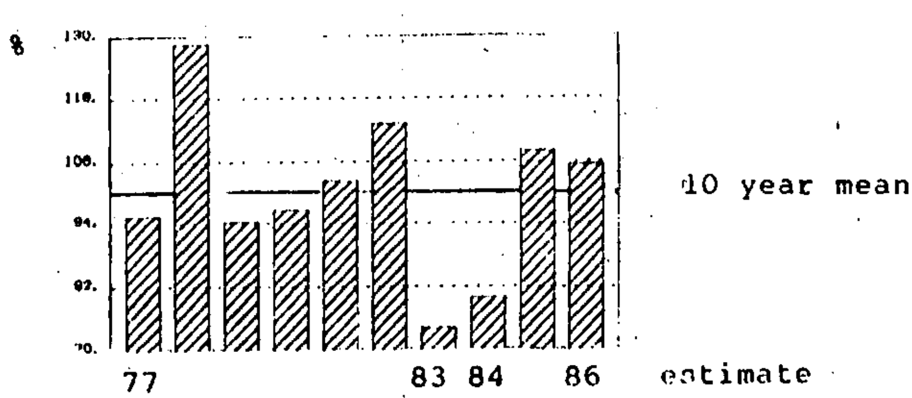
Grower System: Since the early 1980's growers have had the advantages of a positive Umfolozi P & D Committee involvement towards disease control, to provide good quality seedcane and to introduce new varieties. Turnover of extension staff has been minor, communications improved and technological input increased. Irrigation development has taken place and involvement in management techniques by SASEX specialists initiated. The "Integrated Systems" is functional, except for the farm management (economics) system.

Some achievements by the grower system in recent times are detailed:

* Total crop production

In 1983/84 a severe drought took its toll. In 1984/85 devastating floods destroyed permanently land that produced approximately 15% of the total cane crop. Despite this mill throughput was maintained in 1985 and 1986.

Fig.8. Tons cane through the mill as a percentage of 10 year mean (1977-1986).



It is possible to increase yields per hectare even further.

* Use of varieties and good seedcane

The co-operation of growers with the P & D committee has resulted in a reduction in area under smut prone NCo310 and N55/805, and a significant change in variety composition.

Table 2. The change in variety composition 1983 to 1986 as a percentage of total cane area.

1983	% Area	1986	% Area
NCo310	31,1	NCo376	44,4
NCo376	28,9	N.14	17,1
Mix	15,8	NCo310	10,9
N8	10,5	N12	10,2
N55/805	8,4	N8	6,6
	94,7%		89,2%

The large scale use of good seed and good grower selection of variety for environmental adaptability has contributed significantly to total mill production. The increase in NCo376 area against the trends to the north is of concern regarding the smut threat.

* Productivity and management

A pilot project involving 30% of the total cane crop was initiated in 1985. "Estate A" managers at three levels and SASEX staff participated. Management aspects of harvesting and transportation to siding were studied. Cost reduction achievements are given in Table 3.

Table 3. 1986 savings to date (May to Aug) as a percentage of 1985 actual costs.

Item	Savings as a % of 1985 Costs
Harvesting	20
Infield loading	13
Infield transport	16
Transhipment	15
Total weighted average	17%

In addition 26 tractors have been made surplus to requirements.

If this trend is maintained for the season, savings could be in excess of R200 000 despite inflation.

* Data banks

With the co-operation of growers, three main data banks of cane quality (100% participation); field performance (70% participation) and management/economics (proposed) could and will provide invaluable information to participants; extension workers; planners; strategists and managers.

The challenge remains to interpret and use the data constructively.

Table 4 gives one example. 1986 to date differences in cane:sugar ratio performances between the best and worst growers is compared in terms of A. extra R/ton cane revenue to the best grower. B % extra cane that has to be milled by the worst grower to make one ton of sugar.

Table 4. The effect of actual 1986 cane:sugar ratio's TD on A. extra revenue/ton cane and B. extra % cane milled /ton sugar.

HOMO. ZONE	CANE:SUGAR		A	B
	A BEST	B WORST	GROWER EFFECT Extra R/t.c.	MILL EFFECT Extra t.c/t.sugar
1	7,9	9,3	R 5,69	18%
2	8,2	8,6	R 3,38	5%
3	7,5	10,9	R19,82	45%
4	7,4	9,9	R 7,70	34%
5	8,3	10,9	R 9,06	31%
6	8,1	11,7	R11,92	44%
7	7,8	9,8	R 7,70	26%
8	6,9	12,5	R22,29	81%

The best cane:sugar ratios are reasonable. Distribution curves comparing growers/zone with mill average indicate zones 5, 6 and 7 have the greatest cane quality problem. There is potential revenue for grower and miller in "closing the gap".

5. IMPROVE THE SYSTEM

* This must be the aim at all times
* *Measurement and evaluation is necessary for this to happen.*

This does occur at Umfolozi, with the consequence that improvements are taking place.

* To improve the whole "Integrated System" however requires action, interaction and constructive co-operation between its component systems.

T L CULVERWELL
REGIONAL EXTENSION OFFICER: SASEX NORTHERN REGION

FACTORS AFFECTING CANE QUALITY : UMFOLOZI HISTORICAL PERFORMANCE

(1977/78 to 309/9/86 Uf = Umfolozi; IA = Industry Average)

Uf = ——; IA = ----

Fig.2. POL % CANE

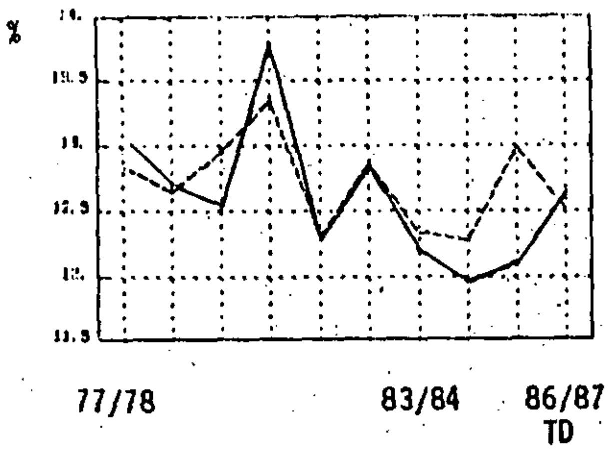


Fig.3. MIXED JUICE PURITY %

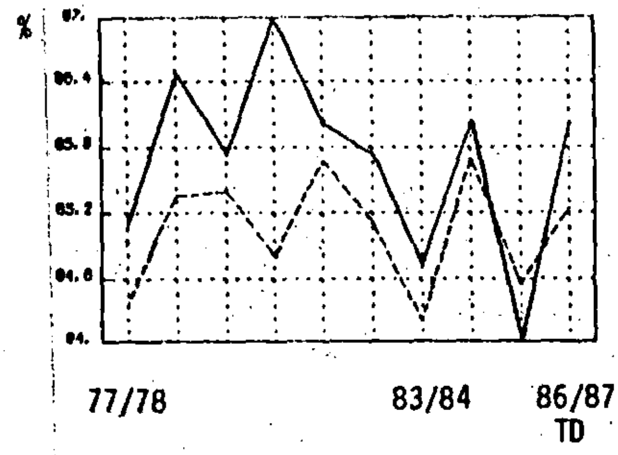


Fig.4. FIBRE % CANE

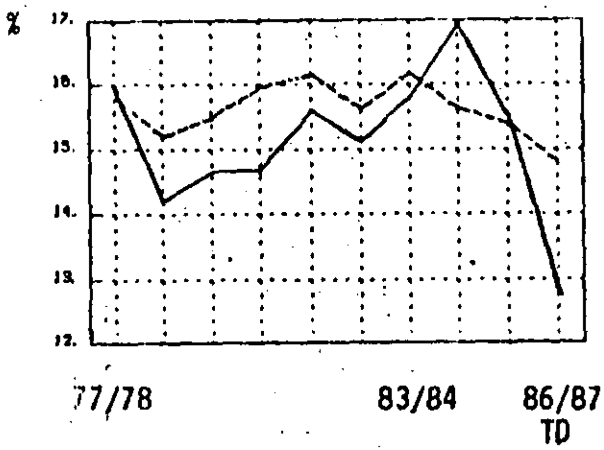


Fig.5. ASH % CANE

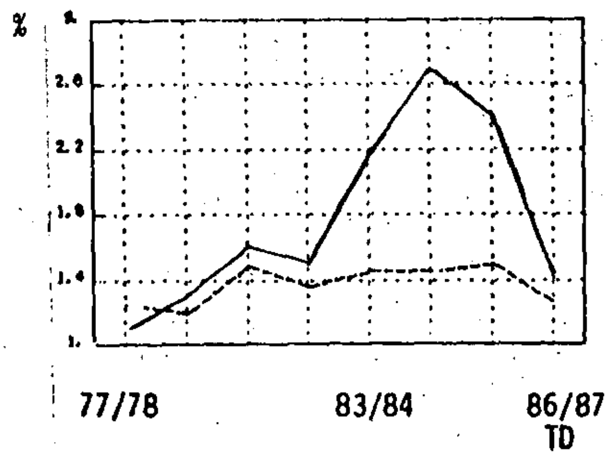


Fig.6. CANE : SUGAR RATIO

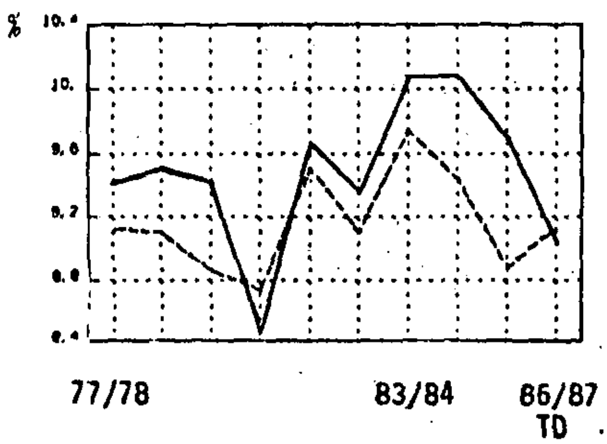
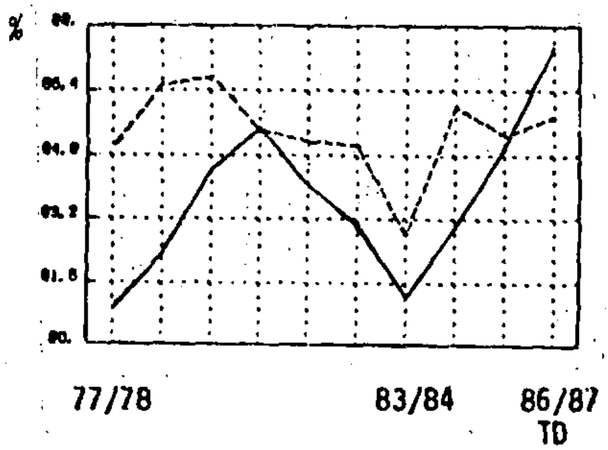


Fig.7. OVERALL RECOVERY %



APPENDIX B
PAGE 1
WEEK NO. 25
WEEK ENDING 20/09/86

SUGAR INDUSTRY CENTRAL BOARD - CANE TESTING SERVICE

pure sugar

[redacted]
P O BOX [redacted]
MTUBATUBA
3935

PLANTER CODE 6231-[redacted]
QUOTA MILL UMFOLOSI
SEASON ESTIMATE SUGAR % CANE 11,23

EST A-POOL SUGAR PRICE: 327,30

DELIVERIES THIS WEEK: DATE	REF.	VAR. CODE	VEHICLE TYPE	CONSIGNMENT OF VEHICLE	TONS CANE		CREDITS: TONS RELATIVE SUGAR	RELATIVE SUGAR % CANE	DELAYS: TONS ERS	TONS SUCF	ANALYSIS: SUCROSE % CANE	FIBRE % CANE	ASH % CANE	PURITY	CO-OP DATA: CANE SUGAR RATIO	RAND/TON CANE	RAND/TON ASH	RAND/TON NETT	NOTES (NoH Pol.)
DIRECT DELIVERIES TO UMFOLOSI																			
16/09/86	0119	02	GREEN	013518	50,670	A	6,381	12,59	6,662	7,647	15,09	12,9	1,8	88,5	7,38	41,27	0,51-	40,76	1·96
16/09/86	0121	02	GREEN	013519	51,275	A	6,458	12,59	6,944	7,738	15,09	12,9	1,8	88,5	7,33	41,27	0,51-	40,76	
16/09/86	0267	02	GREEN	013520	39,815	A	4,604	11,56	4,962	5,666	14,22	13,2	1,9	86,7	7,59	37,89	0,53-	37,36	3·15
16/09/86	0269	02	GREEN	093521	38,835	B	5,138	13,23	5,506	6,109	15,73	13,3	1,5	88,9	7,05	43,3[illegible]	0,18-	43,19	[illegible]
16/09/86	0270	02	GREEN	013521	14,370	B	1,867	12,99	2,003	2,201	15,32	12,3	2,1	89,[illegible]	7,1[illegible]	42,58	0,81-	41,77	1·76
16/09/86	0272	02	GREEN	013522	3,690	B	0,465	12,60	0,500	0,556	15,07	12,9	1,8	88,5	7,3[illegible]	[illegible]	0,50-	40,80	1·76
18/09/86	0569	02	GREEN	013523	51,180	B	6,446	12,59	6,931	7,716	15,08	13,8	2,5	89,0	7,38	41,27	1,22-	40,05	1·26
18/09/86	0570	02	GREEN	013524	23,765	B	2,993	12,59	3,218	3,583	15,08	13,8	2,5	89,0	7,39	41,27	1,22-	40,05	[illegible]
19/09/86	0803	02	GREEN	013525	52,655	B	6,495	12,34	6,994	7,803	14,62	13,2	3,0	88,6	7,53	40,45	1,63-	38,82	1·9[illegible]
19/09/86	0805	02	GREEN	013525	49,205	B	6,351	12,91	6,818	7,566	15,42	14,2	2,2	89,1	7,22	42,32	0,86-	41,46	1·89
19/09/86	0807	02	GREEN	013527	25,935	B	3,251	12,54	3,457	3,890	15,00	13,9	2,5	89,2	7,42	41,11	1,18-	39,93	1·87
20/09/86	1031	02	GREEN	013529	26,710	B	3,248	12,16	3,501	3,910	14,64	11,6	1,3	87,8	7,63	39,86	0,03	39,89	2·[illegible]
20/09/86	1033	02	GREEN	013258	51,310	B	6,347	12,37	6,834	7,604	14,82	11,6	1,4	88,2	7,51	40,55	0,04-	40,51	1·95
20/09/86	1207	02	GREEN	013530	20,130	B	2,453	12,19	2,644	2,947	14,64	11,6	1,6	88,1	7,61	39,96	0,31-	39,65	1·95
21/09/86	1208	02	GREEN	013531	30,325	B	3,411	11,25	3,655	4,257	14,04	10,8	1,3	85,3	8,20	36,88	0,06	36,94	2·[illegible]
21/09/86	1210	02	GREEN	013532	23,015	C	2,939	12,77	3,157	3,495	15,19	11,6	1,2	88,8	7,29	41,86	0,14	42,00	1·92
21/09/86	1219	02	GREEN	013530	32,705	B	4,018	12,29	4,328	4,837	14,79	12,0	1,7	87,5	7,56	40,29	0,34-	39,95	2·11
21/09/86	1337	02	GREEN	013529	3,565	B	0,431	12,09	0,465	0,523	14,67	11,4	1,4	87,2	7,67	39,63	0,05-	39,58	2·15
21/09/86	1338	02	GREEN	013529	3,630	B	0,439	12,09	0,473	0,532	14,66	11,5	1,4	87,2	7,67	39,63	0,06-	39,57	2·15
* TOTAL DIRECT DELIVERIES					552,765		73,735	12,44			14,95	12,8	1,9	88,3	7,47	40·78		Av	1·98
FIELD STATISTICS																			
A. FIELD NUMBER 001B					141,760		17,443	12,30			14,85	13,0		88,0					
B. FIELD NUMBER 002B					426,010		53,353	12,47			14,97	12,8		88,4					
C. FIELD NUMBER 002A					23,015		2,939	12,77			15,15	11,6		88,8					

1B = 518
2B = 425

	TONS CANE	CREDITS	DELAYS	ANALYSIS	CO-OP DATA
PRECISE DELIVERIES THIS WEEK:					
MONTH:					
SEASON:					

2A = 320

SEE NOTES OVERLEAF

REF:UMFC10 - 23/C9/86

CLEAN CANE CAMPAIGN - WEEK & TCDATE REPORT

APPENDIX C

NAME/ GROWER CODE	---GROUP ORDER--- NET CANE PRICE	ASH % CANE	CANE SUGAR RATIO	NET CANE PRICE	CANE SUGAR RATIO		ASH% CANE	SUCROSE % CANE	DAC PURITY	FIBRE % CANE	ZONE	LOADING METHOD
* TC	1	3	1	41,56	7,88		,95	14,48	87,33	12,94	1	C
* TC	2	2	3	41,04 40,65	7,43 8,03	A	,74 ,89	15,09 14,12	87,63 66,92	12,35 12,07	1	C
* TC	3	5	2	37,17 40,32	6,14 7,53	A	,97 1,38	14,46 14,08	84,07 87,03	11,40 12,91	1	C
* TC	4	1	4	36,06 36,58	7,57 8,10	A	,84 ,81	14,35 13,53	86,19 86,23	12,51 12,31	1	C
* TC	5	4	5	36,19	8,55	A	1,04	12,84	85,51	10,51	1	C
* TC	6	6	6	36,68 35,79	8,24 5,37	B	1,46 1,40	14,03 12,74	85,34 84,45	11,58 11,63	1	G
* TC	7	1	1	39,43 40,97	7,70 8,20	A	,90 1,05	14,78 14,28	87,35 86,79	15,63 14,30	2	C
* TC	8	2	2	39,14 39,86	7,76 8,43	A	1,38 1,21	14,59 13,90	87,00 86,36	12,41 12,31	2	I
* TC	9	6	3	33,04 35,17	5,06 8,55	A	1,69 1,97	13,30 13,71	83,44 86,80	14,42 14,40	2	I
* TC	10	4	5	35,96 39,01	8,39 8,64	b	2,37 1,47	13,96 13,59	85,28 86,72	15,25 12,89	2	I
* TC	11	3	4	36,68 38,84	6,24 8,65	B	1,39 1,41	13,88 13,51	86,48 86,77	13,04 12,53	2	I
* TC	12	5	6	37,93 37,37	7,59 8,66	b	1,16 1,80	14,11 13,14	87,37 86,00	12,74 13,50	2	I
* TC	13	2	1	44,35	7,50	A	,94	15,17	89,29	14,39	3	C