752 Expt.
1515 Crops

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

Programme for Annual Meeting

Thursday, 15th November, 1973

9:00 am Chairman's report.

General.

9:30 am Quantity of seedcane and the use of filtercake in establishing sugarcane

- Maxime de Robillard   View or seed condition?

10:15 am Tea

10:45 am Mechanization developments in the sugar industry

- John Hill

11:30 am The processing and interpretation of agricultural records

- Rodger Stewart

12:30 pm Lunch

2:00 pm The implications of the errors incurred in recommending, mixing and applying fertilizer.

- B. Easter, G. Hardy, B. Hulett, J. Boyce, P. Moberly -

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

ANNUAL MEETING

THE EFFECTS OF DIFFERENT QUANTITIES OF SEEDCANE OF TWO VARIETIES WITH AND WITHOUT IRRIGATION AND FILTERCAKE

by G. Iggo and M. de Robillard

Introduction

With the rising cost of labour, growers are becoming more conscious of the high labour demand associated with planting seedcane, especially where the method of using setts is practiced. By placing whole sticks in the planting furrow, labour requirements are reduced as a result of easier handling and fewer operations, but it is not known whether by using this method similar germination to that of setts can be achieved, and if so, what quantity of seedcane is required.

Handweeding, cultivation and the application of herbicides are weed control measures available to the grower, but the shading effect of the cane leaf canopy can assist as a natural form of weed control. Consequently good germination, rapid tillering and the subsequent early development of a full leaf canopy may reduce the labour required for weed control.

An experiment was established therefore to compare the germination and ultimate yield resulting from different planting practices under rainfed and irrigated conditions. The trial was located at Ottawa on a Windermere clay and was planted in September 1972.

A. Treatments

Varieties

(a) NCo 376

(b) N55/805

Irrigation

(a) Rainfed

(b) Irrigation

Over the 12 month crop cycle 339 mm of supplementary irrigation water were applied.

Seed type and rates

T_1	setts
T_2	setts + filter cake
T_3	single whole stick
T_4	single whole stick + filter cake
T_5	double whole stick
T_6	double whole stick + consolidation
T_7	treble whole stick

Notes on treatments

(a) The seedcane used for both varieties was 11 months old first removed from hotwater treated stock.

Average length of stick was 1 metre.

(b) Where setts were used the cane stalk was trashed prior to cutting into "four-eyed" lengths, and placed in the furrow with a ~~25~~ 50% overlap.

(c) The whole stick treatments were left untrashed and placed in the furrow "tip-to-butt".

(d) Filter cake was applied at a rate of 50 tons per hectare in the furrow before planting.

(e) Consolidation was done by a mule-drawn light roller pulled along the planted row after covering the seedcane.

B. Fertilizer

Fertilizer was not applied at planting because of the high P status of the soil, but at 3 months of age the crop was top-dressed with 141 kg N and 141 kg K per hectare.

C. Weed Control

Weed control was achieved by a pre-emergence spray followed by two applications of post-emergence herbicides and an interrow cultivation.

Results

Amount of seedcane used

The weight of seedcane used for each planting method was measured and is shown in Table I.

12-17 [illegible]

Table I

Tons weight of Seedcane used per hectare

Method	NCo 376	N55/805
Setts	6,7	7,3
Single whole stick	4,5	4,7
Double whole stick	7,8	7,9
Treble whole stick	12,3	13,7

Development of Cane Leaf Canopy

Under rainfed conditions and to a lesser degree the irrigated conditions, filtercake increased the development rate of cane leaf canopy. The different seedcane rates had little effect on canopy development with the exception of the single whole stick treatment where canopy developed slowly. Due to the uneven distribution of weeds throughout the trial an assessment on the relationship between planting method and weed population could not be determined.

Yield results

The trial was harvested in September 1973 at 12 months of age. During the cropping period 708 mm of rain were recorded.

Table II

Yield and quality of cane grown under rainfed conditions

Treatment	NCo 376			N55/805		
	tc/ha	ers%c	ters/ha	tc/ha	ers%	ters/ha
Setts	53	10,4	5,6	63	10,8	6,7
Setts + F.C.	71	10,3	7,4	75	11,3	8,5
Whole stick x 1	50	10,8	5,3	47	11,8	5,6
Whole stick x 1 + F.C.	58	10,2	5,9	57	11,3	6,5
Whole stick x 2	63	9,6	6,2	57	10,3	5,9
Whole stick x 2 + consolidation	62	9,7	6,1	59	11,1	6,5
Whole stick x 3	55	11,0	6,3	64	10,9	7,0
Mean	59	10,3	6,1	60	11,1	6,7
Sub-plot CV%	13,2	13,6	15,6	13,2	13,6	15,6
L.S.D. (0,05)	10,5	1,91	1,31	10,5	1,91	1,31
(0,01)	14,4	2,62	1,80	14,4	2,62	1,80

Table III

Yield and quality of cane grown under irrigated conditions

Treatment	NCo 376			N55/805		
	tc/ha	ers%c	ters/ha	tc/ha	ers%	ters/ha
Setts	95	11,8	12,1	113	13,5	15,3
Setts + F.C.	116	12,5	14,6	116	14,0	16,3
Whole stick x 1	70	12,0	9,4	93	14,0	13,1
Whole stick x 1 + F.C.	115	12,2	14,0	102	13,7	13,9
Whole stick x 2	106	12,0	12,7	101	14,4	14,0
Whole stick x 2 + consolidation	106	12,2	12,9	105	14,1	14,8
Whole stick x 3	109	12,1	13,3	115	13,8	15,9
Mean	103	12,1	12,6	106		14,8
Sub-plot CV%	7,3	2,8	6,2	7,3	2,8	6,2
L.S.D. (0,05)	10,2	0,48	1,13	10,2	0,48	1,13
(0,01)	14,0	0,66	1,54	14,0	0,66	1,54

Table IV

Harvested crop characteristics of variety NCo 376 grown under rainfed and irrigated conditions

Treatment	Rainfed			Irrigated		
	Stalks/ha ($x10^{-3}$)	Mean stalk length cm	Mean stalk dia. mm	Stalks/ha ($x10^{-3}$)	Mean stalk length cm	Mean stalk dia. mm
Setts	116	90	22,8	152	128	22,8
Setts+F.C.	126	108	24,3	169	150	23,4
Whole stickx1	106	91	24,7	121	127	23,4
Whole stickx1 + F.C.	105	103	25,3	159	145	23,5
Whole stickx2	120	102	22,6	165	135	23,3
Whole stickx2 + consolidation	124	105	21,9	157	135	22,2
Whole stickx3	131	95	22,1	159	141	23,3
Mean	118	99	23,2	155	137	23,1
Sub-plot CV%	10,2	10,7		5,5	6,2	
L.S.D. (0,05)	15,10	14		10,8	12	
(0,01)	20,68	19		14,7	16	

TABLE V

Harvested crop charcteristics of variety N55/805 grown under rainfed and irrigated conditions

Treatment	Rainfed			Irrigated		
	Stalks/ha ($x10^{-3}$)	Mean stalk length cm	Mean stalk dia. mm	Stalks/ha ($x10^{-3}$)	Mean stalk length cm	Mean stalk dia. mm
Setts	101	92	25,8	137	146	27,3
Setts+F.C.	113	122	24,4	145	157	26,1
Whole stickx1	88	93	25,2	123	126	25,6
Whole stickx1 + F.C.	95	103	27,0	116	147	27,2
Whole stickx2	95	104	25,0	134	138	24,6
whole stickx2 + consolidation	110	98	25,6	138	138	25,2
Whole stickx3	114	106	25,0	153	150	22,8
Mean	102	103	25,4	132	143	25,5
Sub-plot CV%	10,2	10,7		5,5	6,2	
L.S.D. (0,05)	15,10	14		10,8	12	
(0,01)	20,68	19		14,7	16	

5 October 1973

- X:30 am.

SOME NOTES ON A PROPOSED METHOD FOR
SOLVING THE MECHANISATION DEVELOPMENT PROBLEMS
IN THE SOUTH AFRICAN SUGAR INDUSTRY.

BY

J.N.S. HILL

PRESENT PROBLEM

Mechanisation development haphazard

1. Unco-ordinated trials - manufacturers selling drives; individualism and gullibility of farmers.

2. Annual Mech. Day - range getting out of hand and little control possible by Industry.

3. Testing of introduced machines - difficult, land not prepared, labour upset problem on farms.

4. Environmental problem developments - herbicides, conservation, trashing, varieties.

5. Lack of supporting services - training at all levels, adoption of standard simple systems.

PROPOSED SOLUTION

1. Experiment Station to purchase a large 'farm' using the Mechanisation Subsidy Fund; the farm to be carefully selected to provide:

    1,1 a choice of soil types
    1,2 vary degrees of hillside slope.
    1,3 a large enough area to thoroughly test machines and obtain reliable cost data (some 30 000 tons cane per annum and 600 ha.).

2. Station to plan the entire operation with the objective to reduce manpower requirements to the minimum whilst attempting to maintain or improve profits:

    2,1 perhaps the whole 'farm' would need to be layed out and replanted in a relatively short space of time.

    2,2 Selected methods and systems would be adopted and carefully recorded.

3. The assistance required by the 'farm' manager should be noted with the view to providing similar assistance to the Industry (Extension).

2/...

4. 4,1 Annual mechanisation days would fall away (in the present form) and be replaced by a series of demonstration days on the 'farm' when selected implements and farming methods can be presented to the growers. The emphasis would be on selection of machines such that manufacturers would present new equipment for screening and demonstration in order to obtain some form of official approval by the Industry (similar to the screening of herbicides!).

4,2 New and promising machines introduced to the Industry could be tested very thoroughly and unbiased recommendations made to future buyers.

5. A more wholistic approach to research by the Experimental Station would then become possible - and all new developments could be tested in practice and fully evaluated before release or recommendation to the Industry. Some points which come to mind are practical variety testing, improved advice on weed-control systems, row spacing and direction, trash management policies and harvesting/replant cycles.

6. On the 'farm', a practical solution to the mechanisation-conservation compromise will be achieved and can then be spread with confidence through the Industry.

7. Following up the identification of the assistance needs of the 'farm' manager, supporting services offered by the station can be strengthened. Possibly great expansion of the extension department is required? Certainly a changed approach to training is needed.

7,1 Farmers and farm managers need to be trained in farm management principles and practices.

7,2 Standardised and simple procedures can be taught on such aspects as programming and short term decision making, and farm maintenance systems.

7,3 Operator and service mechanic training needs can be positively identified and perhaps even given.

CONCLUSION

It is believed that this scheme will succeed because:

1. Positive, visual and audited proof can be supplied on practical methods of improving farm efficiency.

2. Impact by the Station on the Industry will increase and extension will be improved, thereby increasing effectiveness of the Station (spiral).

3. Positive, controlled guidance can be given to manpower reduction plans and mechanisation development.

In short, no sceptical farmer will be able to get away with saying "Oh, that is just theory, in practice 'these' problems prevent success" or "Well, who couldn't achieve the same result with all that backing!"

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

ANNUAL GENERAL MEETING, 1973.

THE PROCESSING AND INTERPRETATION OF AGRICULTURAL RECORDS

by Rodger Stewart

Introduction

The Agronomists' Association has recently started to process agricultural data in order to assist Estate Agronomists in their decision making and to provide information to the Experiment Station of the performance of cane grown under field conditions. This discussion is centred on the decisions facing Estate Agronomists and Cane Growers.

The information used in this paper is the result of processing the crop data of New Guelderland Sugar Estates for the 1972-73 season and other observations made on this farm over the last 10 years. It must be stressed that not enough data is available at this stage to make any definite statements of optimum farming practices.

Agronomic Problems.

In order to justify the processing of data, the information obtained must be useful for decision making. Listed below are some of the agronomic problems which data processing will assist Agronomists to solve.

1. Optimum stage of plough-out and re-establishment.

With succeeding ratoons the cane plant loses efficiency which can be restored by replanting. The rate of degeneration and response to re-establishment differs with soil type.

2. The optimum age of harvest and percentage of total area harvested.

Crop performance must be related to the age of harvest and percentage of total area harvested to obtain a balanced and efficient farming system.

3. Estimating.

A measure of crop size is essential for budgeting for physical and financial resources.

4. Problem identification.

The performance of a field must be related to a standard for its particular soil and stage to assess its performance.

5. Other interactions.

Many other interactions such as soil v. variety, nutrition v. soil or nutrition v. variety are important factors for the Agronomist.

Measures of performance.

All the above agronomic problems can only be solved if we have a satisfactory measure of performance some of which are mentioned below.

1. Tons cane or sucrose per hectare (T/ha)
2. Tons cane per hectare per unit of nutrient (T/ha/kg N,P,K)
3. Tons cane or sucrose per hectare per unit of time (T/ha/month)
4. Tons cane per hectare per unit of water applied (T/ha/100 mm of water).

All these measures of performance are available from the Agronomists' Association's processed data. However measures 1 and 2 are of limited value as no time restriction is imposed. Measure 3, although related to time, does not reflect the growth conditions during the life of the plant.

In dryland farming rainfall is probably the most limiting resource and it would seem useful to measure performance in terms of this commodity. Measure 4, which embodies this concept, could be improved by relating yield to effective rainfall which will be expanded upon at the end of this paper.

The above measures of performance are in physical terms which must ultimately be converted into economic terms as the criterion for decision making. The response of yield to rainfall and some simplified economic consequences for the agronomic problems listed above are now discussed.

The optimum stage of plough-out and re-establishment.

The cane plant generally shows a decreasing response to rainfall with each succeeding ratoon from planting which forms the basis for decision making as to the optimum stage for re-establishment. Figure 1 shows the trends observable from New Guelderland Sugar Estates data over the last 10 years. It can be seen that soil types display differing degeneration rates.

Figure 2 shows the theoretical economic consequences of this trend for any field or soil type. The total revenue per hectare after deducting harvesting costs is related to total rainfall over the whole crop cycle (ie. from planting to plough-out). Diminishing returns to rainfall (decreasing efficiency of rainfall conversion as the number of ratoons and thus rainfall increase) result. The total revenue per hectare after deducting harvesting costs is a discontinuous function of rainfall but it is shown in Figure 2 as a continuous line.

The total cost of field maintenance per hectare is also shown in Figure 2. The cost AB represents the re-establishment cost and all subsequent field maintenance costs (fertilizer, weed control) over the crop cycle are added to this cost. It is assumed that the cost of field maintenance increases at an accelerated rate as crop maintenance becomes more difficult with the number of ratoons and thus rainfall increasing.

The difference between these two curves provides the relationship between profit per hectare and rain. In order to obtain the optimum stage of plough-out the marginal profit per hectare to unit of rain must be equated to the "price of rain" (ie. an economic value or cost of rain). This could be obtained from the cost of irrigation if the Sugar Industry or any farm was entirely reliant on irrigation. If the "price of rain" was AC in Figure 2 the optimum stage of plough-out would be after the first ratoon and if AD the optimum stage would be after the third ratoon.

The optimum age of harvest

An extract from the Summary by Age from the computer analysis of New Guelderland Sugar Estates' data for the 1972/73 season is given in Figure 3. It is apparent that the cane harvested at a younger age does show a greater response to rainfall. This response is biased because the better fields do tend to be harvested at a younger age. However the biological growth curve does suggest that this trend will always be evident.

Figure 4 represents a theoretical cutting cycle starting with rainfall at zero at the previous harvest date. The revenue per hectare after deducting harvesting costs shows the diminishing returns to rainfall suggested above. This curve only starts when the cane is harvestable.

The total cost of field maintenance (fertilizer, weed control) per hectare is assumed to increase rapidly until canopy of the cane. Thereafter the cost curve flattens out as very little cost is incurred to maintain cane after full canopy.

Again the difference between these two curves will provide the profit per hectare at different levels of rain. The equation of marginal profit per hectare and the "price of rain" will give the optimum rainfall level and thus the optimum age of harvest.

The higher the "price of rain" the more frequently should cane be harvested to obtain the optimum utilization of the scarce resource, rain.

Estimating

The efficiency factor of tons cane per hectare per unit of water (rain) can be used as an estimating tool. By relating the expected response to rainfall for a particular stage, soil type and expected age at harvest to the rainfall received to date and the expected rainfall until harvest a very good idea of a field's yield can be obtained.

This concept could be expanded to provide a production model for the whole of the Sugar Industry to provide a more accurate estimate of crop size for industrial negotiations.

Problem Identification

Standards as suggested by information available from Figure 1 could be used as a means of identifying deviations in performance for individual fields. For example, if a Middle-Ecca field at first ratoon on New Guelderland Sugar Estates were to give a response of 7 tons cane/ha/100 mm of rain a problem could be identified.

A further problem is the less efficient conversion of rainfall by Dwyka soils.

Other interactions

At present insufficient information is available to postulate any meaningful interactions. It is hoped that with the general acceptance of the Agronomists' Association's data processing service that some interesting interactions will become apparent for further research and for improving our farming practices.

Proposals for measuring effective rainfall

A problem encountered with the measurement of performance by tons of cane per hectare per 100 mm of rain is the surplus water which fields receive during periods of high rainfall. This leads to the paradox that during periods of high rainfall the measure of performance (mT/ha/100 mm rain) is lower than that for periods of low rainfall.

An effort must be made to obtain a measure of effective rainfall. The use of a "profit and loss" system for each field as employed on irrigation schemes is too complicated and unnecessarily accurate for the performance standards we require. A simpler system which the computer can handle is proposed. As a basis for discussion, I suggest that for the purposes of obtaining more realistic performance standards we ignore the following surplus water:-

More than 50 mm of rain in any 24 hour period
More than 150 mm of rain in any 7 day period
More than 250 mm of rain in any 30 day period

These proposals would improve our measure of water utilization and enable us to make more meaningful comparisons between years with very different rainfall patterns and between areas with similar climatic characteristics but different rainfall patterns in any period of time.

Conclusion

The observations that have been made can only be quantified with reasonable certainty if we have a large source of accurate data. The crop data required for the S.A.S.I. Agronomists' Association data processing scheme should be readily available. A sample crop data form is attached to this paper.

We, therefore, urge those of you who have any data to submit it for processing by the computer.

31st October, 1973.

S.A.S.I. AGRONOMISTS ASSOC. - ESTATE CROP DATA

ESTATE NAME:

FIELD	SOIL	AREA ha	VARIETY	STAGE	DATES OF HARV		TONS CANE	TONS SUCROSE	RAIN mm	IRRIG mm	TRASH/BURN	FERTILIZER (kg/ha)			t/ha	
					PREV.	PRESENT						N	P	K	LIME	F.CAKE

FIGURE 1: Tons cane/100 mm by stage & soil type for New Guelderland Sugar Est. (circa 1962-1973

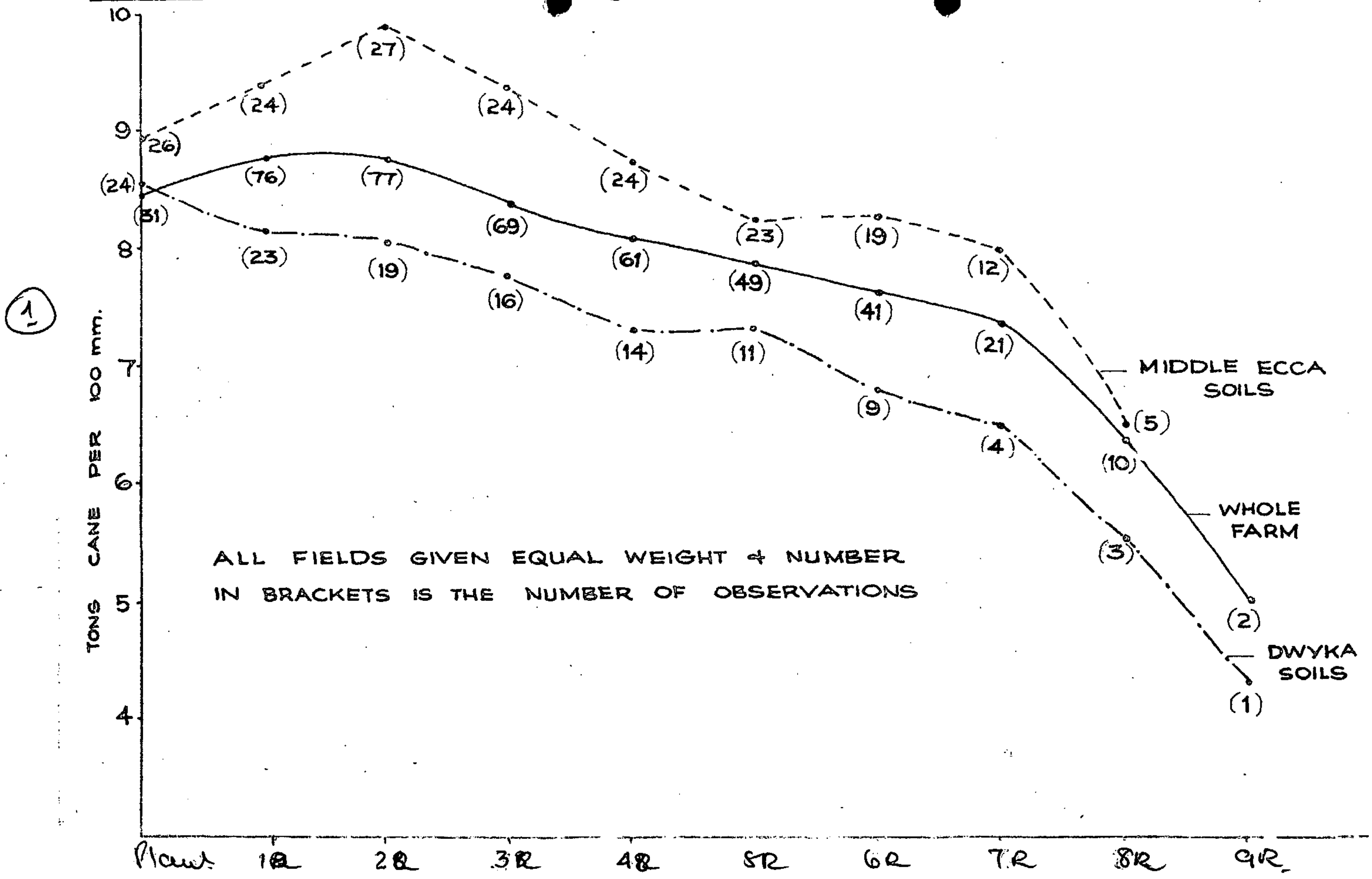


FIGURE 2 The determination of the optimum stage of re-establishment

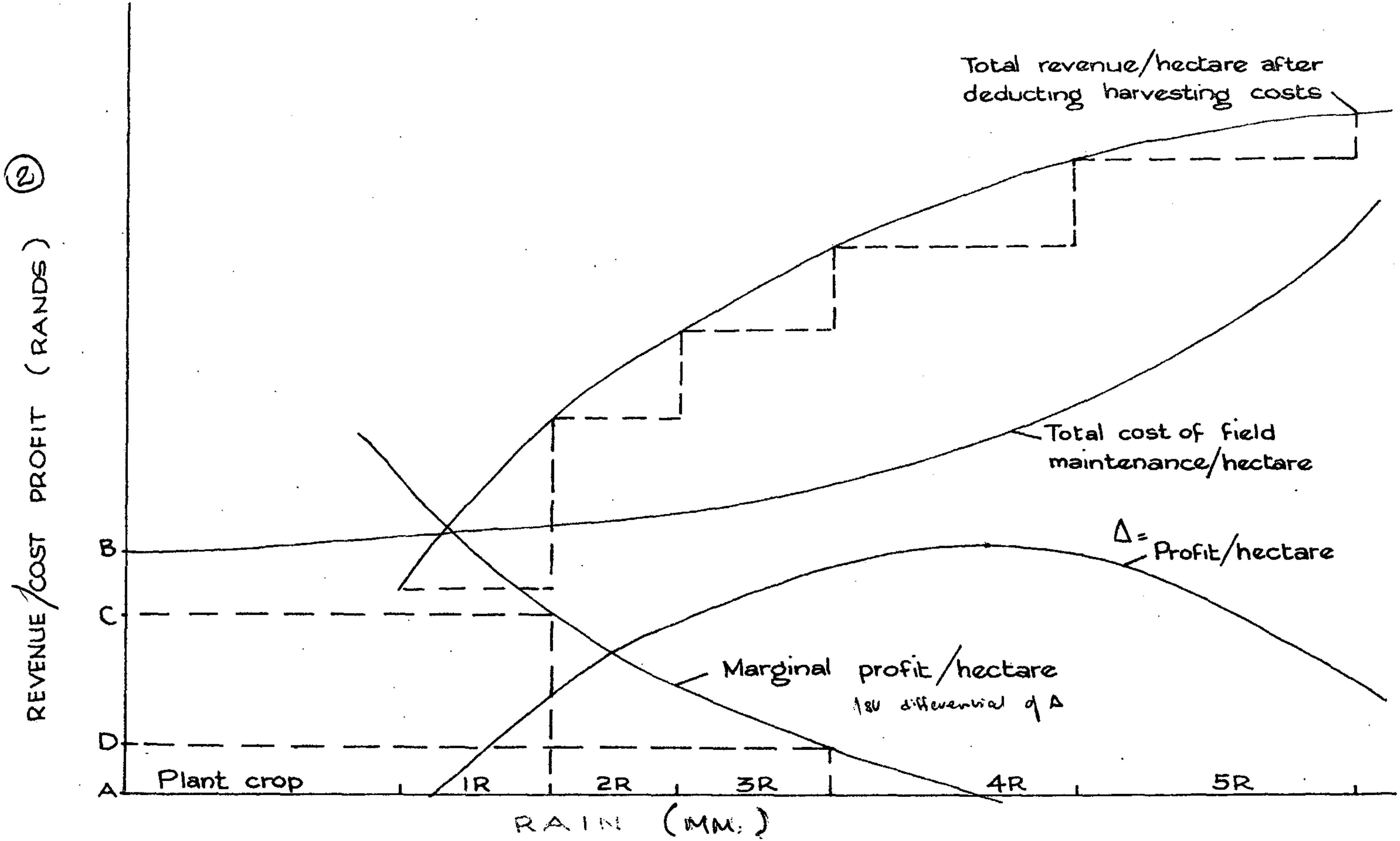
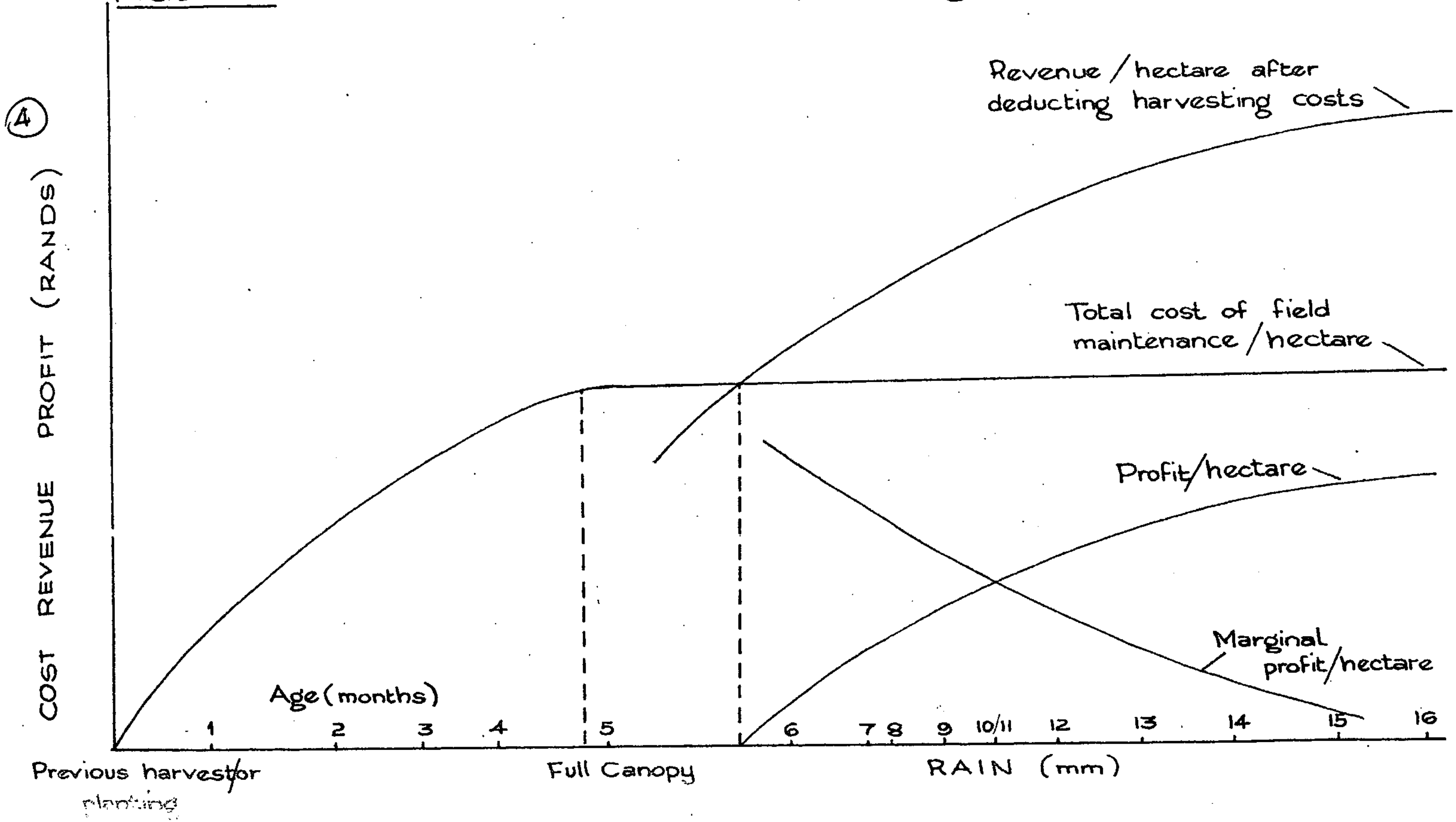


Figure 3. AN EXTRACT FROM THE SUMMARY BY AGE 1972/73 SEASON FOR NEW GUELDERLAND SUGAR ESTATES

TAKEN FROM S.A.S.I. AGRONOMISTS' ASSOCIATION ANALYSIS

	Age (months)	% of area harvested	Sucrose %	T/Ha Cane	T/Ha sucrose	T/Ha/M cane	T/Ha/M sucrose	Water (mm)	Tons cane/ 100 mm	Tons cane/ kg N
	9	0,3	13,6	81,2	11,1	9,02	1,23	739	10,99	0,5
	11	0,7	13,8	116,6	16,1	10,60	1,47	953	12,23	0,4
	12	11,1	13,8	98,9	13,7	8,24	1,14	1075	9,20	0,6
	13	10,6	13,2	99,7	13,2	7,67	1,01	1120	8,90	0,6
	14	2,0	13,7	104,2	14,3	7,45	1,02	1197	8,71	0,6
	15	7,1	12,9	104,4	13,5	6,96	0,90	1337	7,81	0,7
	16	2,2	13,1	108,5	14,2	6,78	0,89	1395	7,78	0,7
	17	13,7	13,8	106,8	14,7	6,28	0,86	1391	7,68	0,6
	18	8,8	13,0	109,0	14,2	6,06	0,79	1659	6,57	0,7
	19	9,7	12,6	123,8	15,6	6,52	0,82	1899	6,52	0,7
	20	6,8	12,7	121,7	15,5	6,09	0,78	1853	6,57	0,9
	21	5,8	12,8	141,0	18,0	6,71	0,86	2309	6,10	1,1
	22	4,2	13,4	146,2	19,5	6,65	0,89	2306	6,34	1,1
	23	8,2	13,1	156,8	20,5	6,82	0,89	2315	6,77	1,1
	24	2,4	13,5	116,2	15,7	4,84	0,66	2351	4,95	0,9
	25	1,2	14,2	145,5	20,6	5,82	0,82	2497	5,83	1,0
	27	5,4	13,9	146,4	20,4	5,42	0,75	2435	6,01	1,2
Averages	18		13,2	118,4	15,7	6,54	0,87	1678	7,06	0,8

FIGURE 4 The determination of the optimum age of harvest



SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

by B.R.D. Easter

The presence of potassium, calcium and magnesium in the soil in adequate amounts and in suitable proportions to one another and to other exchangeable cations such as aluminium and ammonium ions is necessary if the soil is to be a suitable medium for plant root development.

Maximum economic returns from farming enterprises are almost always obtained only when the soil fertility is maintained at an optimum, ie. nutrients are present in adequate, not excessive, amounts and in correct proportions. What is implied is that fertilizer potassium can be adjusted downwards with increasing levels of available soil potassium.

The extraction method currently used gives a good indication of potassium availability. Soil testing does provide the farm operator with a measure of the fertility level of his soil and fertilizer applications of the essential nutrients P, K, Ca and Mg can be adjusted to maintain economic crop yields at all times.

Owing to the absence of a suitable N-P-K mixture formulation it has been necessary to recommend the nearest available mixture 4-1-6. As mixture-formulation recommendations are based on the nitrogen requirement of a crop, 4-1-6 is always excessive in potassium.

A problem associated with cationic nutrients NH_4^+, Na^+, K^+, Ca^{++} and Mg^{++} is that of monovalent: devalent ion ratio becoming too wide, as a result of overfertilization with potassium by use of 4-1-6. Another factor which must also be considered is that potassium is readily leached from the soil and excessive potassium fertilization must be considered as wasteful. This means that either (i) plants will absorb a cation in excessive amounts to the detriment of other cations, resulting in an imbalance of nutrients in the plant or (ii) nutrient potassium is leached from the soil without the plant making any nutrient use of it.

This means that there is no corresponding increase in yield from the fertilization practice and suggests, in other words, inefficient and uneconomical use of a potassium.

If phosphorus is not required as a natrient then 1-0-1 (47) is recommended and is generally a suitable alternative to recommended straight. It seems logical therefore that when phosphorus is required this approximate N:K ratio should still persist and a more suitable N-P-K formulation would be 7-1-8 or 5-1-6 (refer Survey of 1972 Fertilizer recommendations).

When 4-1-6 is recommended as the alternative mixture the rate of potassium overfertilization generally ranges between 25 kg K and 75 kg K per hectare. If 4-1-6 (42) is used, which is the cheapest 4-1-6 grade per kg of nutrient, this overfertilization with potassium is costing the grower between R4-30 and R12-80 per hectare. Based on the tons plant food sold to the sugar industry as 4-1-6 (all grades) supplied by one of the fertilizer companies overspending amounts to:

Nutrient	Tons plant food (as 4-1-6)	Total tons plant food (mixtures + straights)
N		
N	3679	14006 (4)
P	969	2925 (1)
K	5211	13115 (4)

Assuming an 'ideal' ratio of N:K being 1:1,14 an excess of 1017 tons potassium were purchased from this company alone. The sugar industry has therefore spent R172,890-00 on potassium in excess of that required for balanced nutrition.

SURVEY OF 1972 FERTILIZER RECOMMENDATIONS

N-P-K RATIO

Region	n.	7-1-10	7-1-7	7-1-5	9-1-10	9-1-7	9-1-5	5-1-5 and 5-1-7
		%	%	%	%	%	%	%
Lower South Coast	35	26	31	17	3	-	-	23
Midlands S. Coast	39	44	13	10	3	8	3	21
Durban North Coast	13	23	23	23	8	8	-	16
North Coast Central	122	29	17	12	20	2	6	12
Tugela	20	50	10	5	5	5	-	25
Central Zululand	7	14	29	14	14	14	-	14
North Zululand	60	45	20	7	10	2	7	10
Midlands	27	37	22	7	19	-	11	4
Eastern Transvaal	14	7	-	14	14	14	-	50
Pongola	8	25	38	-	-	-	13	25
TOTAL n =	345	33%	19%	11%	13%	4%	5%	15%

Explanatory notes:

n: F.A.S. 4-1-6 recommendations during 1972

N-P-K ratio: Actual ratio of N:P:K where 4-1-6 was recommended.

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

NOTES ON SOME FACTORS AFFECTING THE EFFICIENCY OF FERTILIZER USE

By J.G. Hardy - Doornkop Sugar Co.

A. Hand mixing of straight fertilizers

An investigation was carried out to determine the efficiency of handmixing straight fertilizers. The procedure was as follows:-

A mixture of straight fertilizers (Urea, Super (8,3) and Muriate of Potash) was prepared by each of the three sections of the Estate. The programmed mixtures were:-

Section "A" mixture : 15,3% N; 2,8% P; 16,7% K

Section "B" mixture : 23,0% N; 2,4% P; 10,8% K

Section "C" mixture : 18,4% N; 3,6% P; 8,0% K

Each of the three mixtures was sampled as follows:-

6 bags of the mixed fertilizer were taken at random, and sampled at the top 1/3 rd, middle 1/3 rd, and bottom 1/3 rd, for each bag. Samples were taken:

i) just after mixing and bagging in the mixing shed

and ii) after transport to the fields.

All samples collected were sent for analysis, and the results showed the following:-

TABLE I Deviations from expected analysis
Estate Average (54 samples)

Actual analysis as % of expected analysis	% Frequency					
	NITROGEN		PHOSPHATE		POTASH	
	After Mixing	After Transport	After Mixing	After Transport	After Mixing	After Transport
56 - 65%	-	-	-	2,0	5,5	-
66 - 76%	9,3	5,9	-	2,0	3,7	7,8
76 - 85%	13,0	13,7	-	7,8	16,7	7,9
86 - 95%	48,1	25,5	9,3	13,7	13,0	11,8
96 -105%	25,9	33,3	25,9	39,2	27,8	23,5
106 -115%	3,7	19,6	40,7	15,7	20,4	27,4
116 -125%	-	2,0	14,8	17,6	11,1	5,9
126 -135%	-	-	3,7	2,0	1,8	13,7
136 -145%	-	-	3,7	-	-	2,0
146 -155%	-	-	1,9	-	-	-
C.V.	10,3%	12,3%	10,4%	13,5%	14,0%	16,6%

TABLE II Variation within the bag, before and after transport to the field, expressed as a percentage of the total amount of each element found at the different portions of the bag. Estate average (18 samples)

Portion of Bag	NITROGEN		PHOSPHATE		POTASH	
	After Mixing	After Transport	After Mixing	After Transport	After Mixing	After Transport
Top 1/3 rd	33,6	33,5	33,3	33,9	32,4	31,5
Middle 1/3 rd	33,1	33,1	32,7	33,4	33,8	33,8
Bottom 1/3 rd	33,3	33,4	34,0	32,7	33,8	34,7

It would appear that there is a tendency for a settling down of K Cl, and an upward displacement of super taking place in the bag, following transport of the mixed fertilizer. The increased variation found between samples taken after transport, as compared to before transport, as shown in Table I, seems to support the idea of separation of the mixed fertilizer during transport. However, the variations between the bags were quite large, and the interpretation of those results could be misleading.

It can be suggested that unless there is excessive shaking of the bags taking place during transport of the mixed fertilizer, it is doubtful whether the variations found will be of much practical significance.

B. Infield variation of hand-applied fertilizer

It is not uncommon practice to see fertilizer being applied by hand without any sort of calibration at all. Usually, lots of fertilizer bags are placed around the field to be top-dressed and the respective area to be covered by each lot of fertilizer is guessed by the "induna" in charge, and the fertilizer is then applied by hand.

An investigation was carried out to try and determine the variation which could be expected using the above method of fertilizer application.

Ten plastic strips, each 8 m long, were placed at random on the cane line, in the field to be top-dressed. The fertilizer application was then carried out as per the above practice (on each of the three sections of the Estate).

The fertilizer on each individual strip was collected, weighed, and a sample taken for analysis.

The results obtained showed the following:-

TABLE III Deviations from programmed application rate

Estate average (30 samples)

Rate applied as % of programmed rate	% Frequency	
35 - 45%	3,3	
46 - 55%	-	
56 - 65%	13,3	
66 - 75%	20,0	
76 - 85%	10,0	
86 - 95%	6,7	30%
96 - 105%	13,3	
106 - 115%	10,0	
116 - 125%	3,3	
126 - 135%	3,3	
136 - 145%	3,3	
146 - 155%	3,3	
156 - 165%	6,7	
166 - 175%	-	
176 - 185%	-	
186 - 195%	-	
196 - 205%	3,3	
C.V.	39,0%	

As was expected, great variability in application rate was found between the samples taken. A study done in Mauritius (re: M.S.I.R.I. Annual Report 1968, pp 100-103) on 207 observations made on 8 different estates showed a range of variation in fertilizer applied by hand, from 20 to over 250%, which compares closely to the above figures. These figures show, without doubt, that there is room for substantial improvement in the fertilizer application.

To summarize, it can be suggested that:-

i) Handmixing of straight fertilizers is not advisable unless very strict supervision of the mixing operation is feasible.

ii) In order to try and improve on the lack of efficiency in fertilizer use, mechanical fertilizer spreader should be used wherever possible. Where land topography does not allow the use of tractors, some sort of mechanical distributor handled by one operator could be developed. One such equipment has actually been developed in Mauritius, and results obtained from this distributor are shown below:-

(Re: M.S.I.R.I. Ann. Report 1968, pp 100 - 103)

Average Application Rate	No. of tests	Variation in Application Rate	C.V.
114 kg	8	112 - 117	1,4%
153 kg	6	147 - 159	3,7%
182 kg	5	174 - 190	3,5%
274 kg	4	269 - 278	1,6%

A similar machine is being developed by a commercial firm at present, and it is felt that such a machine should have good potential under our conditions. It is also claimed that labour efficiency might possibly be increased as compared to hand application.

6 October 1973

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

SOME NOTES ON THE VARIABILITY IN FERTILIZER APPLICATION ON AN ESTATE BY B. HULETT

The figures given in Table 1 are from one season which was taken at random.

Table 1. Application rate variance from recommended

ESTATE		AREA T/D (ha)	AVERAGE VARIANCE %	MAXIMUM VARIANCE %	NO. OF FIELDS T/D
1	Over applied	219	16,8	43,0	14
	Under applied	303	- 11,5	- 26,2	19
	Average	522	0,3		33
2	Over applied	264	18,8	57,8	18
	Under applied	134	- 11,9	- 36,9	8
	Average	398	8,5		26
3	Over applied	136	6,5	12,2	10
	Under applied	94	- 17,4	- 35,8	8
	Average	230	- 3,3		18
4	Over applied	48	10,0	25,8	4
	Under applied	48	- 10,0	- 15,0	5
	Average	96	0,0		9
5	Over applied	81	11,9	46,3	10
	Under applied	85	- 8,1	- 22,7	4
	Average	166	1,6		14
6	Over applied	425	10,5	50,8	24
	Under applied	106	- 8,4	- 21,8	7
	Average	531	6,7		31
7	Over applied	241	17,5	32,0	15
	Under applied	119	- 11,0	- 16,0	8
	Average	360	8,0		23
TOTAL	Over applied	1412	13,9	57,8	95
	Under applied	891	- 11,3	- 36,9	59
	Average	2303	4,1		154

Errors such as those shown in Table 1 may arise for various reasons, the most important of which are:

(a) Lack of supervision
(b) Inefficient machinery
(c) Incorrect recording
(d) Field area
(e) Row width

and possibly some other but less significant factors.

(a) Lack of supervision - this applies to both hand application and machine distribution of fertilizer

(b) Inefficient machinery - no matter how well trained the operator might be, if the machine is inefficient then errors in application will occur.

(c) Incorrect recording - This can give a result vastly different from the actual.

(d) Field area - areas used are the areas as shown from an aerial survey plan. No account is taken of the slope of the land and the error increases with slope as shown in Table 2.

Table 2. Area variance with different degrees of slope

% Slope	% Variance in area
10	0,5
20	2,0
30	4,4
40	7,7
50	11,8
75	25,0
100	41,4

(e) Row width - since fertilizer calibrations assume a certain length of line per hectare any variation in row width will result in errors in application rates

Table 3. Error with variation from assumed row width (1,37 meters assumed here)

Variation (Meters)	Error (%)
0,15	11
0,30	22
0,46	34
0,61	44

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

ANNUAL GENERAL MEETING - 1973

MIXING FERTILISER FOR UNIFORM FIELD APPLICATION

by John Boyce

Introduction

As long ago as 1967, the problem of uneven distribution of fertiliser was recognised at Tongaat. At that time, fertiliser was railed to Tongaat, collected by road transport and delivered to sections for storage and subsequent mixing. Mixing of concentrated fertiliser straights for individual fields was done by hand on sections. Evidence of streaks, striping and patches of yellow cane and poor growth in sugar-cane fields led to the conclusion that the efficiency of the distribution of high grade concentrated fertilisers required investigation.

Mechanical Mixing of Fertiliser

It was felt that the problem of poor hand mixing could be overcome in several ways. Low grade bulky fertilisers could be applied separately to improve distribution, or commercial mixtures could be used to avoid mixing problems, whilst the third possibility was to mix high grade fertiliser straights properly using a mechanical mixing plant.

An economic exercise was carried out to evaluate these three possibilities. The following costs were calculated:-

(i)	The use of low grade bulk fertilisers applied separately to fields,	R234 880
(ii)	The use of the commercial mixture 4-1-6(31) in accordance with its nitrogen status,	R291 840
(iii)	The use of concentrated fertiliser straights mixed locally,	R202 560

From these cost comparisons, it was concluded that mixing concentrated straight fertilisers was by far the cheapest procedure. The above costs included mixing and/or the

2/...

application by hand. There was a saving of some R32 000 over the first alternative of using low grade bulky fertiliser materials applied separately in the fields. When compared with the second alternative of applying the commercial mixture 4-1-6(31), the saving amounted to nearly R90 000 per annum.

A series of tests was conducted to determine the efficiency of hand mixing. Samples were taken either from the fertiliser which had been mixed on the floor, or from fertiliser which had been rebagged after mixing, or after transport to the field for application and, in one case, samples were taken during application in the fields. The results of these tests are presented in Appendix 1, but in general, the following points were noted:

(1) There was no consistent trend in variation for either nitrogen, phosphorus or potassium with depth of sample in the fertiliser bags.

(2) There was no general tendency for any nutrient to move in the bags during transport to the field.

(3) The variation in nitrogen between bags was as low as 6% on occasion and exceeded 40% on other occasions.

(4) Phosphorus which is normally the nutrient in lowest concentration nevertheless appeared to be reasonably well mixed on all occasions.

(5) Potassium was undoubtedly the nutrient which showed the greatest variation from bag to bag. This variation was as low as 9% on one occasion, and as high as 96% on another occasion.

It was estimated that approximately 2 tons of cane per hectare could be lost in plant cane, due to poor mixing of both nitrogen and potassium. It was assumed that no significant losses of cane took place as a result of poor phosphorus distribution. It was also estimated that for ratoon crops, approximately 2 tons of cane per hectare could be lost due to poor nitrogen distribution, from all ratoon fields fertilised. It was assumed that no losses due to poor mixing of phosphorus or potassium occurred in ratoon fields. Since approximately 6 400 hectares of cane was harvested, 1 200 of which would be plant cane, the total loss of cane due to poor mixing was estimated to be 17 600 metric tons, i.e. 4 800 tons of plant cane, and 12 800 tons of ratoon cane. The estimated increase in tons of cane as a result of correct mixing of fertilisers was halved to 8 800 tons and used in an economic exercise to justify the installation of the mixing plant and storage facilities. It was found that labour costs for mixing were similar for both hand and mechanical methods.

3/...

Following the tests which were carried out during 1967, it was decided that a centralised fertiliser mixing plant should be constructed at Tongaat. The proposal entailed the building of a warehouse conveniently sited, with siding facilities in the factory area. A forklift truck would be used to transport and load fertiliser. Pallets would be used to facilitate the handling of the fertiliser bags. A concrete mixer with a capacity of 400 Kg of fertiliser was installed in the warehouse, together with a simple bagging, weighing and bag closing system.

Split Applications & a Standardised Rate of Application

It was apparent during the 1971/72 season that mechanical mixing of fertiliser had not entirely solved the problem of achieving uniform field application of fertiliser. Large areas of cane were obviously showing fertiliser deficiencies which could be attributed to poor fertiliser distribution and/or leaching losses during this high rainfall period. In order to solve this problem, a combination of two policies was adopted to promote better fertiliser distribution.

First, it was decided that all fertiliser applications would be split, since the double application would promote uniformity of fertiliser distribution.

Secondly, the amount of fertiliser applied per hectare was standardised at approximately 500 Kg per hectare. With high grade concentrated fertilisers and single applications, the amount of fertiliser applied per hectare ranged from 150 to 650 Kg per hectare. Standardising the amount of fertiliser to be applied per hectare would also promote uniform fertiliser application.

The consequences of splitting applications and standardising the rate of applications were as follows:

(1) It became necessary to change from the high concentrate source of nitrogen, Urea, to the low concentrate fertiliser, ammonium sulphate. With Urea, there was insufficient bulk to obtain two applications of 500 Kg.

(2) The cost of delivered fertiliser increased not only because of the higher price of ammonium sulphate, but also because of the increased railage costs arising from the greater bulk to be transported.

(3) The costs of mixing and handling at the central fertiliser shed increased because of the greater bulk.

(4) The costs of transport from the fertiliser shed to sections increased.

(5) The cost of labour on sections for fertiliser handling and application in the field also increased, not only because of the increased bulk, but also because of the split application.

(6) Because of the large amount of fertiliser to be mixed at the shed, the commercial mixture 1-0-1 (47) was purchased, rather than mixed at the fertiliser shed, and this further increased costs.

Although this combination of policies increased costs considerably, the field results have been good. It is noteworthy that the mechanical mixing plant and storage facilities at the central fertiliser shed provided the flexibility for these policies to be feasible. In effect, the mixing of available fertilisers was carried out to promote good distribution.

In addition to providing mixtures to promote good distribution, provision was made for extra top-dressings to be applied wherever necessary.

Furthermore, mechanisation of fertiliser application was expanded rapidly, the timing of fertiliser applications was improved, and finally the recommended rates of application of nitrogen and potassium were increased.

Conclusions

(1) Mechanical mixing of fertilisers is economically justifiable and provides the flexibility required to use mixtures with any given specifications.

(2) High concentrate fertilisers have distinct advantages, but these advantages appear to have been lost because of poor fertiliser distribution in fields. If this is due entirely to management problems, then steps should certainly be taken to recoup the advantages which have been lost. Such steps should include training at all levels, improved supervision and greater all-round attention to detail.

(3) The problem of poor fertiliser distribution in sugarcane fields can be solved in several ways. If local mixing is economically worthwhile, mechanical mixing is also desirable. With split applications, standardised at 500 Kg/ha, the use of a low-concentrate source of nitrogen is mandatory, as are the costs associated with it. Local hand or mechanical mixing will permit mixing to suit these policies.

(4) The current commercial mixture 4-1-6(38) has an excessively high potassium content. It appears that the nitrogen and potassium contents in such a mixture should be the same (e.g. 5-1-5). If this change could be made, the resulting mixture could be used more economically for ratoon crops which require phosphorus dressings.

Appendix 1 ANALYSES OF MIXTED FERTILISER

SOURCE OF SAMPLES		N%	P%	K%
1. Mixed on Floor	a	16,8	3,0	21,6
	b	19,2	4,5	18,4
	c	17,0	3,7	19,6
	d	18,6	3,9	17,6
2. Rebagged after Mixing A	Top	19,2	3,7	17,6
	Middle	17,9	4,0	20,0
	Bottom	21,4	3,9	19,2
Rebagged after Mixing B	Top	22,6	3,6	16,8
	Middle	20,5	4,1	17,2
	Bottom	18,7	4,4	21,2
Rebagged after Mixing C	Top	23,5	3,5	16,4
	Middle	20,0	4,4	21,2
	Bottom	18,8	4,1	22,8
Rebagged after Mixing D	Top	22,9	4,5	13,6
	Middle	19,4	4,5	20,4
	Bottom	19,1	4,1	23,2
3. After Transporting A	Top	19,4	3,5	19,2
	Middle	21,7	3,5	20,4
	Bottom	22,8	4,6	13,2
After transporting B	Top	20,7	4,3	17,6
	Middle	22,6	4,3	21,6
	Bottom	20,9	3,2	22,0
After transporting C	Top	20,2	4,1	21,6
	Middle	21,1	3,8	20,0
	Bottom	21,9	3,8	19,2
After transporting D	Top	19,6	4,3	18,4
	Middle	20,9	4,3	16,0
	Bottom	20,5	4,3	18,0
4. Infield during Application	a	20,3	5,2	14,0
	b	18,6	4,0	19,2
	c	21,8	4,1	12,0
	d	20,9	4,5	16,4

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

OCTOBER 1973 MEETING

THE USE OF HIGH LEVELS OF FERTILIZER

by P.K. Moberly

The words 'high levels' must first be defined. In this context they refer to levels of fertilizer higher than those likely to be recommended by the Fertilizer Advisory Service at Mount Edgecombe (F.A.S.).

In an article as brief as this it is impossible to attempt a comprehensive assessment of the implications of using high levels of fertilizer under all the various climatic and soil conditions prevailing in the South African sugar industry. Results are therefore briefly presented of some of the more recent experiments in which high levels of fertilizer are used. Certainly no reference is made to the 'old' and valuable R.F.T. and 3^3 series of experiments which helped to establish the current threshold values for soil and third leaf.

1 Placement of fertilizer

Before comparing the effects of fertilizer levels, it is perhaps necessary to ascertain whether methods of application are equally efficient.

1.1 Phosphorus

Two recent experiments compared methods of top-dressing superphosphate on an Inanda soil with high P fixing properties, and on a Makatini soil with low P fixing properties. Results in tc/ha from these two experiments are presented in Table 1.

Table 1: The effect on yield (tc/ha) of various methods of applying superphosphate to established cane

Treatment	Inanda	Makatini
	(mean of R1 & R2)	(mean of P, R1 & R2)
Control : No P	37	122
Broadcast	100	135
Banded on surface near row	92	132
Banded on surface on row	-	130
Banded 20 cm deep near row	68	132

Pre-treatment soil analysis for the Inanda and Makatini soils respectively were 7 and 8 ppm.

Comments

In a soil with high P sorption properties, broadcasting was better (particularly over a trash blanket) than the other methods used, whereas in a soil with low P sorption properties it is immaterial how the supers are applied.

1.2 Nitrogen and potash

A Cartref sand (K 22, P 263 ppm & pH 6,15) was used to test various methods of applying to ratoon cane 670 kg 1-0-1(47). The results in tc/ha are presented in Table 2.

Table 2: The effect on yield of applying N and K in different ways to ratoon cane

Treatment	tc/ha
Control	39
Broadcast	52
Banded on surface on row	50
Banded on surface near row	53
Banded 20 cm deep near row	55
S.E.	±3,9

Comments

Provided distribution is even, these relatively soluble mineral fertilizers can be applied by any method.

2 High levels of N P K

The results are given of four experiments in which high levels of N P K were used.

2.1 Inanda series : Eston

A ratoon field had reportedly been top-dressed with 1120 kg 4-1-6(31) (127 N : 31 P : 189 K) and despite this, looked poor. A simple experiment was superimposed on the established cane using Gromor chicken manure @ 13,4 t/ha applied in a furrow in the inter-row, and the same quantities of N P & K as contained in the Gromor applied in the form of mineral fertilizers. The yield results are given in Table 3.

Table 3: The response to high levels of chicken manure and N P K

	tc/ha	ers%	ters/ha
Control: 1120 kg/ha 4-1-6(31)	89	12,6	11,3
13,4 t/ha chicken manure	115	11,5	13,2
350 N : 60 P : 200 K	113	11,7	13,2
S.E.	±4,6	0,37	±0,70

Comments

i) Levels of fertilizer much higher than would normally be recommended were beneficial despite the marked depression of 1,0 ers% from the high levels.

ii) Further investigations are under way on the same farm in an attempt to establish which of the three nutrients is limiting on these soils. To date the only results of interest are a marked response of 20 tc/ha to filtercake in the furrow, and an indication from leaf nutrient ratios (J. Meyer) that P is deficient despite the application in the furrow of 156 kg P/ha.

2.2 Inanda series : Umbumbulu

On an Inanda soil an experiment was established to compare, amongst other things, Gromor chicken manure alone, Gromor balanced with P & K, Gromor plus N P K and N P K. The results are given in Table 4.

Table 4: The response to chicken manure with and without N P K

Treatments	tc/ha	ers%	ters/ha
1 Control N75 : P75 : K100	121	12,5	15,1
2 5,6 t C.M. + N75 : P75 : K100	138	11,6	16,0
3 5,6 t C.M. + N75 : P14 : K43	143	11,6	16,5
4 5,6 t C.M. (160N : 56P : 67K)	125	11,9	14,8
L.S.D. (0,05)	14	-	-

Comments

i) On comparing treatments 1 & 4 there is some evidence that 50% of the total N in this chicken litter is available.

ii) At a yield level of 120 t/ha F.A.S. would advise 150 N/ha, which in this case would have been acceptable.

iii) There is a marked depression in ers% with the higher levels of fertilizer.

2.3 Inanda soil : Umbumbulu

For six crops the following treatments have been compared:

F0 : Nil

F1 : 1000 kg/ha 4-1-6(31) (N 113 : P 28 : K 169)

F2 : 2000 kg/ha 4-1-6(31) (N 226 : P 56 : K 338)

The responses to the various levels are shown overleaf in Table 5.

Table 5: The response to high levels of N P K over a period of 10 years

	tc/ha		ts/ha
	F1 - FO	F2 - F1	F2 - F1
Plant	54	15	+ 2,7
R1	49	23	+ 2,9
R2	54	14	+ 1,3
R3	58	6	+ 0,4
R4	58	17	+ 0,4
R5	54	7	- 0,8
			$\bar{x}$ + 1,2

A more detailed look at the fifth ratoon results is warranted in Table 6.

Table 6: The effect of high levels of N P K on yield and cane quality in particular

	tc/ha	ers%	ters/ha	purity%	D.M.%	Pol%D.M.	t D.M./ha
1000 kg 4-1-6(31)	114	14,5	16,6	94,2	29,2	53,7	33,2
2000 kg 4-1-6(31)	121	13,2	15,8	91,1	27,5	52,6	33,2

After 10 years the effect of the different fertilizer levels on soil is shown in Table 7.

Table 7: The long term effect of high levels of N P K on Inanda soil

	ppm		
	P	K	pH
Nil	14	87	5,6
1000 kg 4-1-6(31) x 6	20	144	5,4
2000 kg 4-1-6(31) x 6	44	195	5,3

Comments

i) F.A.S. advice, based on 140 t/ha, would be 175 kg N/ha or the equivalent of 1500 kg/ha 4-1-6(31).

ii) For the first three crops the high levels would have been economically sound, but because of the build-up of nutrients in the soil, the depressing effect on cane quality was so severe that in the last three crops the high level of fertilizer would have been uneconomical.

2.4 Avoca series : Mtunzini

The results of an experiment, identical in design to 2.3, which was continued for five crops and eight years on an Avoca soil are given in Table 8.

Table 8: The response to high levels of N P K on cane yield and quality

	tc/ha		S % C	ts/ha
Crop	F1 - FO	F2 - F1	F2 - F1	F2 - F1
Plant	15	13	- 0,02	2,24
R1	28	18	- 0,46	1,89
R2	33	18	- 0,45	2,37
R3	33	24	- 1,15	2,11
R4	48	22	- 1,63	1,65
			Mean	2,05

The soil pH after the eight years of treatment was as follows:

FO 6,4 F1 6,2 F2 5,8

Comments

i) At a mean yield level of 110 t/ha the F.A.S. recommendation, based on N, might have been 138 kg N/ha as 1200 kg/ha 4-1-6(31). With a mean response of 2,05 ts/ha however, the high level of 2000 kg/ha is economically sound.

ii) The decline in cane quality with successive crops at the F2 level is similar to that seen in experiment 2.3.

iii) Unlike experiment 2.3 however, the response in tc/ha tends to increase with successive crops as the FO & F1 yields declined.

3 High levels of N

3.1 Makatini/Shorrocks series : Pongola

Seven twelve month old crops all cut in October/November have been harvested from the 4 x 3 x 2 factorial at Pongola, and the results are given overleaf in Table 9.

Table 9: The response to high levels of N in a Makatini series (ters/ha)

N levels	Nil	55	110	165	F.A.S. level	Optimum Level
Plant	9,8	10,6	10,4	10,4	90	55
N levels	Nil	82	165	248	F.A.S. level	Optimum Level
R1	12,8	13,9	14,4	14,7	175	82
R2	16,9	18,4	19,0	17,8	162	165
R3	11,6	13,4	14,0	13,4	170	165
N levels	110	137	165	192	F.A.S. level	Optimum Level
R4	17,5	17,9	18,0	17,2	186	137
R5	17,4	16,8	16,2	16,0	169	110
R6	14,0	14,1	14,1	13,4	133	110

The effect of N on ers% has been consistent although not large as might be expected for an October/November harvest. The results for R1 and R6 are given below.

ers%

R1	0	82	165	248	kg N/ha
	10,6	10,4	10,2	10,2	
R6	110	137	165	192	kg N/ha
	13,4	13,2	13,0	13,0	

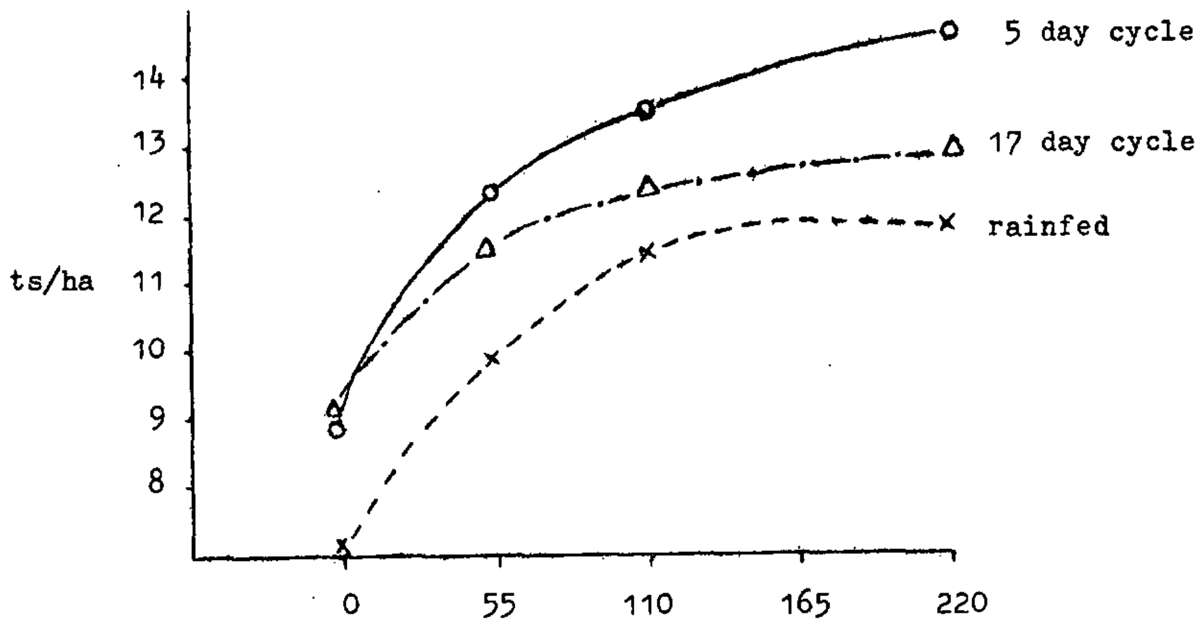
Comment

i) For estimating the optimum level the cost of N is taken as 18 c/kg, 4-1-6(31) @ R55 per ton, and sucrose @ R45 per ton.

ii) In general the recommended levels of N would be too high as this soil is apparently capable of mineralizing a great deal of N.

3.2 Waldene : Shakaskraal

Using three irrigation treatments, control, 25 mm effective on a 5 day cycle and 25 mm effective on a 17 day cycle the response to four levels of N on a Waldene series was measured. Results of R3 are presented graphically below.



Comments

i) F.A.S. level of N at the mean tc/ha would be 115 kg/ha which would be optimum for the dry-land and 17 day cycle treatments.

ii) There is a slight indication that higher levels of N are warranted under irrigated conditions.

3.3 Shortlands : Mtunzini

The performance of eight varieties on Shortlands soil at two levels of N are given in Table 10 for the plant crop.

Table 10: Yield in ters/ha of eight released varieties at two levels of N

	75 kg N	150 kg N	Difference
NCo 310	12,1	11,7	- 0,4
NCo 376	11,3	11,7	+ 0,4
N7	11,6	10,8	- 0,8
N55/805	11,2	10,7	- 0,5
N53/216	10,5	11,3	+ 0,8
CB36/14	10,0	10,7	+ 0,7
N6	10,4	10,3	- 0,1
N8	9,4	9,6	+ 0,2
Mean	10,8	10,8	-

Comments

i) F.A.S. recommendation would be 90 kg N/ha whereas 75 kg N is adequate on average.

ii) Differential variety responses to N appear to exist. The accumulation of more data of this kind by L. Rossler will enable more accurate predictions of variety x N responses to be made.

4 Levels of P

Responses to P vary markedly with soil type.

4.1 Makatini/Shorrocks : Pongola

A soil with a very low P status (4 ppm) responded to three levels of supers as indicated in Table 11.

Table 11: The response in ters/ha to three levels of supers applied in the furrow at planting

	ters/ha		
	45 kg P/ha	90 kg P/ha	135 kg P/ha
Plant	13,4	12,6	13,2
R1	16,2	15,9	16,2
R2	20,5	20,2	19,9
R3	12,8	13,5	13,0

The effect on ers% of excessive P is shown below for the plant, R2 and R3 crops.

	ers%		
	45 kg P/ha	90 kg P/ha	135 kg P/ha
Plant	11,8	11,4	11,4
R2	13,6	13,5	13,1
R3	10,6	10,4	10,4

Comments

i) F.A.S. level would be 80 kg P/ha whereas 45 kg was adequate for three crops. Obviously this soil was capable of mineralising large quantities of P.

ii) The depression in ers% due to excessive P was statistically significant.

4.2 Makatini/Shorrocks : Pongola

On the same soil as 4.1 different levels of supers were top-dressed on P deficient cane when the soil P was 1 ppm. The results are given in Table 12.

Table 12: The response to top-dressing superphosphate on P deficient cane (ters/ha)

	R1	R2	R3
Control : No P	13,2	16,5	11,7
42 kg P/ha top-dressed	17,2	20,7	15,1
83 kg P/ha top-dressed	17,8	21,7	14,7
42 + 42 kg P in furrow & top-dressed	17,4	21,7	15,1

Comments

Despite the low level of soil P, 42 kg P was adequate for three crops. F.A.S. levels would be 30 kg P/ha per crop.

4.3 Inanda series : Eston

Plant cane which had reportedly received at planting 138 N, 69 P, 138 K, indicated low leaf P (0,16%) and was poorly grown. Different levels of P, amongst other treatments, were tested in an experiment superimposed on the plant crop. The results are given in Table 13.

Table 13: Responses to high levels of P broadcast onto plant cane

	tc/ha	ers%	ters/ha
Control	40	11,1	4,5
42 kg P/ha	55	10,7	6,0
252 kg P/ha	66	10,6	7,0
10 t/ha chicken manure	74	10,7	7,9

Comments

Laboratory tests (J. Meyer) and these field tests indicate that the Inandas are very high P fixing soils.

4.4 Griffin series : Mowbray

In an attempt to saturate the P fixing properties of a typical, highly leached Midlands ferralitic soil, high levels of supers were applied and incorporated prior to planting, and P was also applied in the furrow. Results of some of the findings in the plant crop are given in Table 14.

Table 14: The response to high levels of P applied to the plant crop

	tc/ha	ers%	ters/ha
F.A.S. single supers	116	12,0	14,0
2,25 t/ha supers + F.A.S.	127	11,9	15,1
4,5 t/ha supers + F.A.S.	141	11,5	16,2
6,75 t/ha supers + F.A.S.	132	10,7	14,1
40 t/ha filtercake in furrow	143	10,0	14,3

Comments

i) Approximately 4,5 t/ha single supers (374 kg P) were necessary to satisfy the P requirements of this soil.

ii) The high P treatment yielded as well in tc/ha as did filtercake, and quality was superior in the case of the supers.

5 High levels of K

The results of two recent experiments using moderate and high levels of K are given below.

5.1 Clansthal : C.F.S.

In a sand with > 3000 ppm Ca and < 90 ppm K, the Ca:K ratio is likely to be a limiting factor to growth. Four applications each of 330 kg K_2SO_4 were applied at 2-3 weekly intervals and the results compared with a conventional top-dressing of 400 kg KCl/ha. The results are given in Table 15.

Table 15: The response to high levels of K on Clansthal sand

	tc/ha	ers%	ters/ha
200 kg K/ha	92	12,6	11,6
800 kg K/ha	106	13,0	13,7
S.E.	± 8	±0,24	±1,11

Comments

The response is not statistically significant and neither was third leaf analysis significantly affected.

5.2 Shorrocks/Makatini : Pongola

Results from seven crops of the 4 x 3 x 2 factorial in which 110 kg K/ha have been compared with Control, are now available. The response in ters/ha is given in Table 16.

Table 16: The response to annual applications of 110 kg K/ha in ters/ha

Plant	R1	R2	R3	R4	R5	R6
0,1	0,2	0,6	0,2	0,9*	0,8*	1,4*

Comments

i) The relatively small but significant ($P > 0{,}05$) responses in the last three crops are surprising in that the soil K was above the threshold value.

ii) For an outlay over the seven years of approximately R40 the extra gross return would approximate R190.

6 Conclusions

6.1 High levels of fertilizer have a most severe depressing effect on cane quality, and this should be borne in mind particularly with the advent of an ers cane payment system.

6.2 Greater attention could perhaps be paid to the mineralizing properties of soils, as these qualities obviously differ markedly. It seems likely that in general, excessive N is being applied to the Hutton and Shorrocks forms for example.

6.3 The Midland mistbelt soils seemingly require very different treatment from the average in regard to P requirements.

6.4 Further precision regarding nitrogen requirements of different varieties would be of value.

6.5 Current threshold values remain a useful guide.

PKM/DC
7 November 1973

AA AGM. 15 / 11 / 73. 9th

1. Committee (3): Clive
   Graeme. * | Egypt [illegible] Dir. [illegible] [illegible]

2. Guests: Rob – Tate Osaris [illegible] – New Members – [illegible] to [illegible]
   Cary Peter Lloyd 4/1/74 C Baan.
   (Mike Dewy) Rodger – George Newant.

3. Proceedings – Bibliography – no reps.

4. Catalogues (752) xx – (1315) methods.

5. R.S.A. results.

6. Research papers.

7. Activities.

8. Members – E Browne.
   G Hardy
   W. Black.

This year?

Meth. Disc group.

$\frac{1}{6}\frac{600}{340{,}000} \times 100$

0.17%

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

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(ii) Forms of nitrogen fertilizer.
(iii) Irrigation
(iv) Weed control

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(ii) Depth of furrow experiments (J. Boyce).
(iii) Irrigation and drying-off experiments (J. Hill).
(iv) Heat treatment of cane setts (L. Allsopp).
(v) Land preparation trials (E. Gilfillan).
(vi) Filter cake experiments (R. Wyatt).
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(ii) An overseas visit (J. Hill)
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